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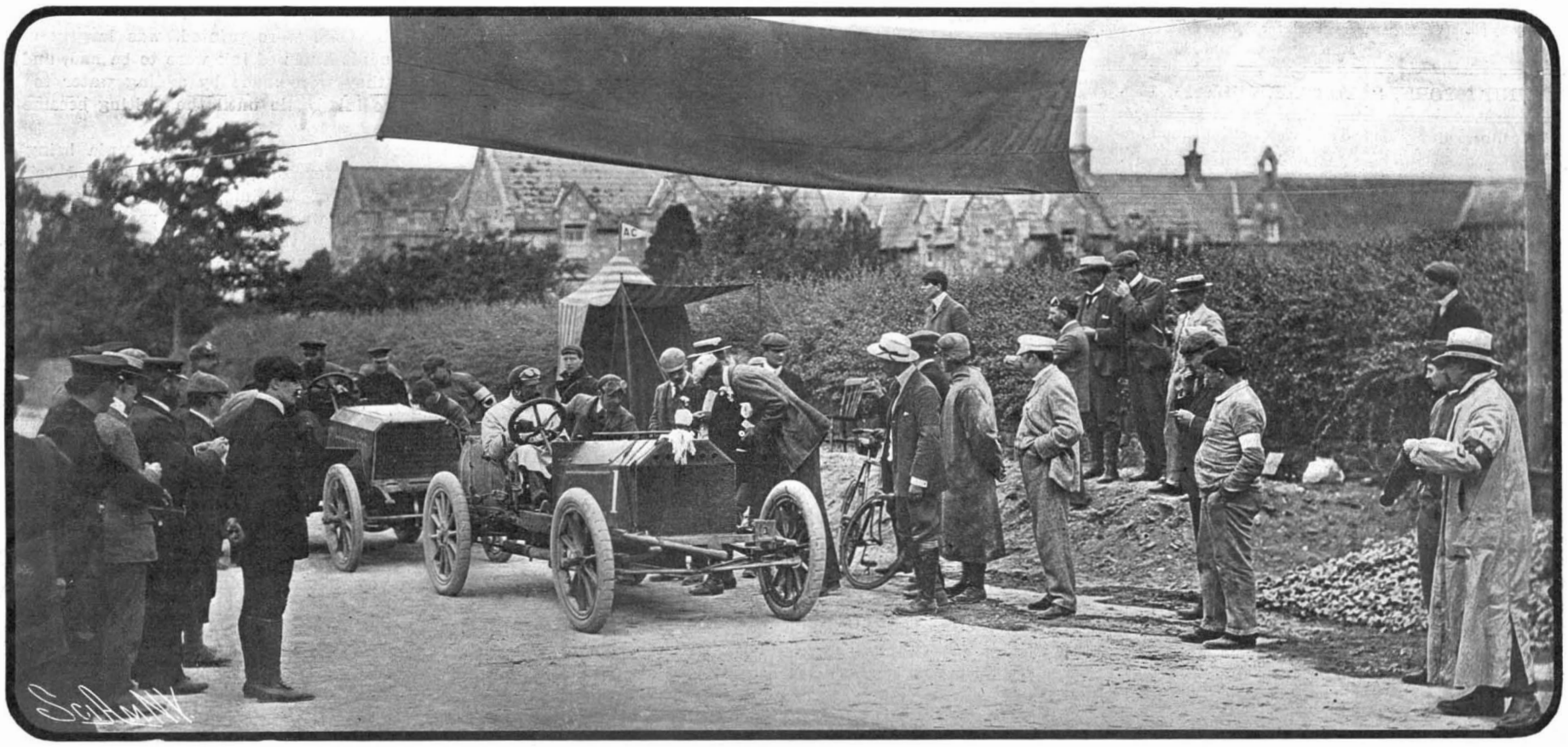
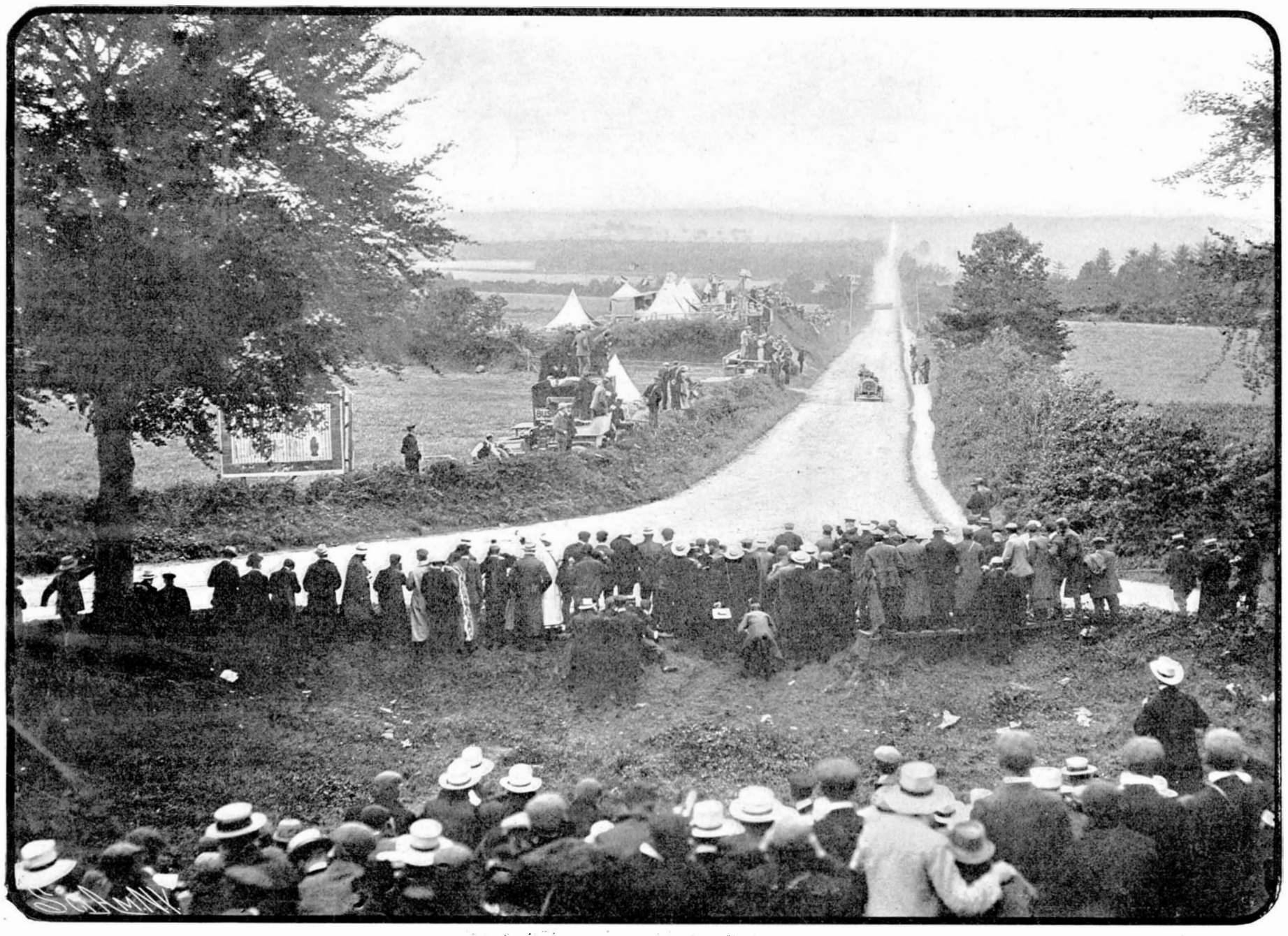


In the Athy Control. The First Car is Mr. Edge's Napier, the Second Baron de Knyff's Panhard.



Baron de Caters Climbing the Hill at Ardscull.

THE AUTOMOBILE RACE IN IRELAND FOR THE GORDON-BENNETT TROPHY.—[See page 61.]

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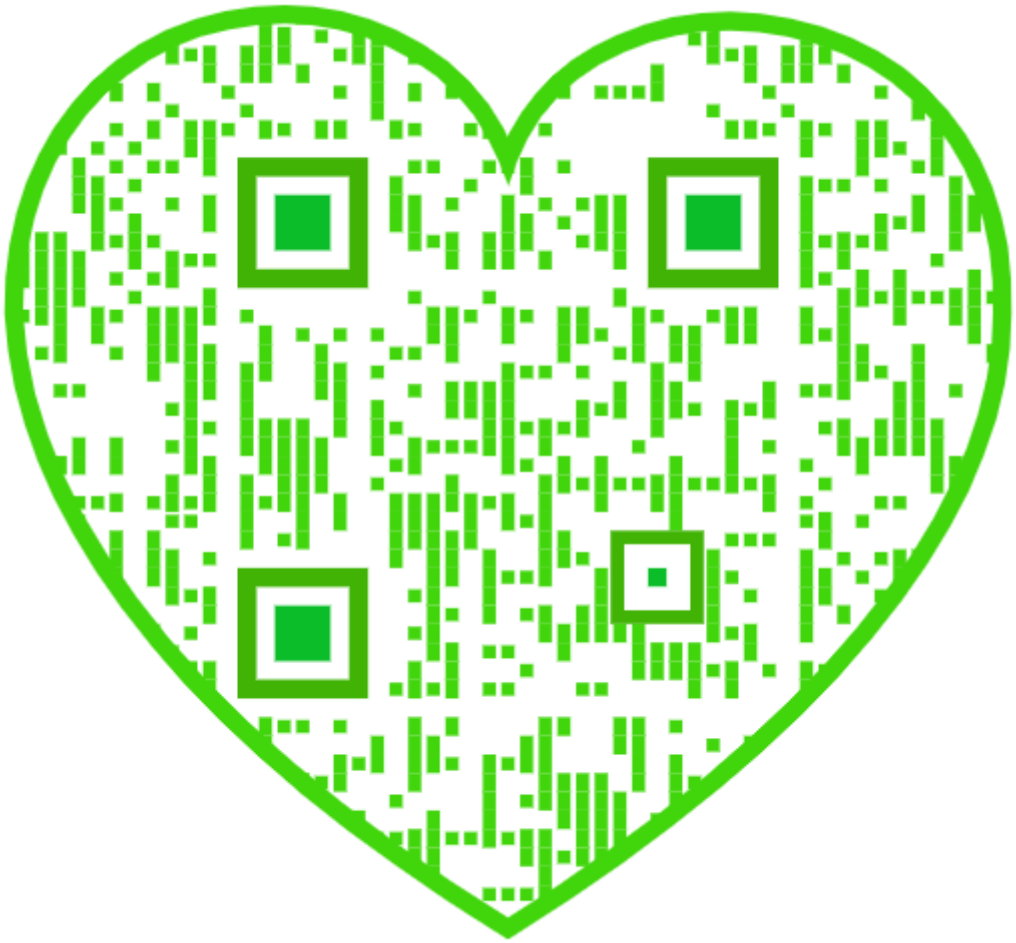

SCIENTIFIC AMERICAN

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JULY 25, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PUBLIC APPROPRIATIONS AND THE BOARD OF ALDERMEN.

We cannot believe that the Board of Aldermen of this city realize the serious consequences which will result from their action in holding up the appropriation of $6,000,000 which is required for building the new Manhattan Bridge. The ostensible reason for their action is the objection which these gentlemen have to a certain type of construction which the Bridge Commissioner proposes to use in this bridge. The question of the merits or demerits of the design, however, is a purely technical one; and in spite of the fact that it has been favorably indorsed by a board consisting of the most eminent bridge engineers of this country, and that the question is so pre-eminently technical that the worthy aldermen through no fault of their own are entirely incapable of passing any intelligent opinion on it, this body of laymen have undertaken to block the bridge for so-called technical reasons. On another page of this issue we discuss at some length the engineering and architectural considerations which favor the eye-bar, as against the chain-cable type; but just now we wish particularly to point out how serious is the responsibility incurred by the Board of Aldermen in their present obstructionist attitude. The new bridge is intended to give immediate relief to the shockingly-overcrowded conditions on the present Brooklyn Bridge, and it is pretty certain that until the former is opened these conditions will grow steadily worse, for the Williamsburg Bridge is too far distant up the river to divert any appreciable proportion of the Brooklyn Bridge travel to itself.

In the presence of the disgraceful, unchivalrous, and altogether unmanly riot that occurs every night at the Manhattan entrance of the Brooklyn Bridge, the mere question of whether eye-bars or wire shall enter into the construction of the bridge which is being built to alleviate these conditions is comparatively trivial. If any of the aldermen who are holding up this appropriation doubt what we say, let him take his stand any evening on the platform above the trolley track loops, and spend the hour from half past five until half past six watching the rough-and-tumble fight of men, women, and children. Let him take note how strong men, as they rush brutally to get the coveted seats on the car, will sweep aside frail women and young girls. Let him see weak men and women thrown down, trampled upon, and dragged from the surging mob with injuries which, in some cases during the last few months, have proved fatal. When he remembers that these people are the representative toilers of the greatest city in a country, which boasts itself upon its advancement in everything that makes for the betterment of the physical and moral conditions of the race, it may, perhaps, begin to dawn upon him that in preventing the construction of the new bridge, he is committing something that approaches a crime against the very citizens who have elected him to his office. But if it is a fact that the Board of Aldermen have held up the appropriation with a full realization of the misery which their action is producing, the New York public will have to take what comfort it can from the reflection that "whom the gods destroy they first make mad," and that the gentlemen of this Board, many of whom would not know a bridge eye-bar from a latchkey, represent the stragglers of an old order of things in city government of which we are shortly to see the last.

THE MERCHANTS' ASSOCIATION AND THE NEW RESERVOIR.

Although we have had occasion to differ with the Merchants' Association of this city in some of their criticisms of recent changes at Croton Dam and Jerome Park Reservoir, we heartily approve of their efforts to make public the slipshod way in which some of these changes appear to have been carried through. Of the wisdom of substituting solid masonry for a core-wall embankment at the Great Croton Dam, we have never had the slightest doubt; and if the new extension is built in the same careful way that has characterized the masonry work of the completed portion, there is no doubt that the city will secure in this great structure one of the most perfect works of its kind ever built. As our readers are well aware, we have also approved of the original proposal of the late chief engineer to substitute here and there at the Jerome Park Reservoir a solid retaining wall carried down to rock in place of an earth-and-core-wall dam in which the core wall rested upon a more or less pervious and unstable material. These changes, however, were originally proposed only for certain limited sections of the perimeter of the reservoir, where the foundation was doubtful; but it now seems that a solid wall has been built, not merely where the foundation was doubtful, but also on long stretches of work where it seems to us there could have been no question of the stability of an earthen core-wall dam had it been built as in the original plan. The question of the expediency of carrying the more costly solid masonry wall continuously along the whole western side of the reservoir, irrespective of the quality of the foundation, is one for expert opinion to decide; but while there may be a division of opinion as to the desirable extent to which the change should be carried, there can be no question as to what quality of wall should be built. It should be of the very finest rubble masonry that first-class rock and the highest grade of cement can produce. First-class cement mortar requires as one of its ingredients sharp river sand, or its equivalent, and it was this material that was called for in the contract specification. The contractors requested to be allowed to crush up the rock that they were excavating and use it in place of this sand, contending that equally good cement mortar could be obtained by its use. Here is another question for expert opinion, and we must confess that for ourselves we would, of the two materials, prefer every time to use sharp river sand. The contractor, however had his way; the wall has been built with its crushed rock mortar; and now it begins to look as though the retaining wall as built is an exceedingly poor and slipshod structure, inasmuch as water which has accumulated from time to time on the outside of the wall has had no difficulty in finding its way through the wall to the interior of the reservoir, and in some cases in considerable quantity. Moreover, in places where the inflow of water through this supposedly impervious wall has been considerable, there has been washed through and deposited at the base of the wall a slime whose solids looked very suspiciously like the crushed gneiss rock which the contractor was permitted to substitute for sharp river sand. It may be that the contractor will be able satisfactorily to explain this condition of things. We sincerely hope for his own sake and for the sake of New York city that he can; for the contractor for the Jerome Park Reservoir is also the contractor for the New York Rapid Transit Subway, and neither he nor the city can afford to have the slightest question of the first-class quality of his work attach to any of the important municipal contracts he has in hand.

INDUSTRIAL CHEMISTRY IN THE SOUTH DURING THE CIVIL WAR.

It is difficult for anyone in the North who was not a participant in the civil war to appreciate thoroughly the great sufferings that were experienced by those who lived in the Southern States at that time. The continual blockade along the water-front on the east and south, the armies on the north, the Mississippi River and the mountains on the west, made it almost impossible for the introduction of materials essential for the proper carrying on of a great war. The heroic struggle waged under these disadvantageous circumstances make the four years' combat one of the most remarkable wars of modern times.

A description of the efforts made in scientific directions has never been satisfactorily written, but within a few weeks, in a pleasant way, under the title of "Applied Chemistry in the South During the Civil War," Prof. John W. Mallett, of the University of Virginia, spoke before the Chemical Society of Washington of some of his experiences.

In beginning, he referred to the great lack of preservatives that were essential, and indeed required, for the preservation of food. Fortunately, the salt deposits in Louisiana were promptly thought of, and advantage taken of their existence for exploitation and production of that every-day essential, so that an ample stock at least of the preservative was soon available. The supplies of coffee and tea were very soon exhausted, and substitutes were introduced. For coffee roasted beans of various kinds, sweet potatoes, and cereals, came into every-day use, and the leaves of various herbs were employed in place of tea. The joy of the first cup of coffee after the close of the war formed a delight that can never be forgotten. The necessity of preserving the cattle, and the employment of horses in the army as well as the demand by the soldiers for shoes, soon exhausted the leather supply. As a result leather became such a rarity that a good pair of boots at the close of the war was worth several hundred dollars in Confederate money. As a substitute, fibers were worked up and coated with a varnish, forming a sort of material similar to oilcloth, which came into use for many purposes. The employment of petroleum oil as an illuminant was at its beginning. Colza and other oils were similarly used at that time, but these soon disappeared, and the old-time candle dip prevailed. For purposes where an oil was absolutely essential, recourse was had to fish oil. Paper was very scarce, and there were but few, if any, mills in the South, and these produced a very inferior quality of paper, so that for writing purposes the blank leaves of old account books were employed, and for printing purposes wall paper, on which many newspapers of the time were printed, was largely used. Only the crudest kinds of ink were to be had, and in most cases they were made by adding water to the refuse in the ink bottle until the writing became so faint as to be scarcely visible.

The great coal deposits of Pennsylvania being no longer available for fuel, recourse was had to the bituminous beds of Virginia, although of course in many cases wood was all that was required. It goes without saying that the supply of paint rapidly disappeared. However, there were numerous deposits of ocher that were available, and crude varieties of paints were soon manufactured in sufficient quantities to supply the demand.

One of the important, indeed necessary, elements in the carrying on of a war is artillery, and to fight without gunpowder is practically impossible. Accordingly, gunpowder mills were established at several localities in the South. The supply of niter was soon exhausted, and search was made for that material in caves and elsewhere throughout the South. These yielded a certain amount, but the future was provided for by the establishment of niter beds. Still, the end came too soon to permit of their being available. There were no sulphur deposits in the South, but fortunately at the beginning of the war there was a large supply of that article in New Orleans, where it had been used in the clarification of sugar. Charcoal was of course more readily obtainable, and after some experiments it was found that the wood from the cotton-wood tree yielded the most satisfactory material.

The manufacture of fulminate of mercury for percussion caps was carried on to a limited extent, and the copper for the caps was obtained from the turpentine stills, which were all collected from North Carolina and used for that purpose.

There were four principal medicines required, namely, quinine, morphine, ether, and chloroform. These were procured, so far as possible, by smuggling, either through the lines or by blockade runners, and numerous substitutes were introduced. For instance, for quinine bitter barks were used wherever possible, especially dogwood, and the dread malaria was by this means held practically in check. Morphine was almost entirely brought in by means of the blockade runners.

At the beginning of the war there were no large metallurgical works in the South, with the single exception of the iron foundries at New Orleans and Richmond. The early capture of New Orleans left in Richmond the only large available foundry, and the Tredegar Iron Works became the principal source for articles made of iron. For ores, recourse was had to the deposits from the South, and it was necessity that led to the exploiting of the deposits of iron in Alabama and elsewhere along the Appalachian Mountain range; indeed, a primitive blast furnace was erected where the city of Birmingham now stands. Copper was had to a limited extent from the Ducktown Works in Tennessee, but more largely from the stills, as previously mentioned, that had been used in the manufacture of turpentine. Lead and zinc were only to be had in limited quantities, and were obtained chiefly from mines in Virginia.

M. Albert Dion, of France, has patented a new navigable balloon construction, in which an attempt is made to overcome the inherent defects of the present types of dirigible aerostats, viz., deficiency of rigidity and liability to distortion, with a tendency to rupture in high winds. In his design, M. Dion has made the gas bag conform more to the shape of a shuttle, terminating in a sharp point at either end. The frame supporting the car below is carried nearly the entire length of the balloon. At the top of the balloon is a curious backbone of light material extending from end to end, from which a light column extends vertically through the envelope of the gas bag, passing through a hole in the lower side fitted with a ring. The ribs of this backbone serve to carry the frame containing the car and motor. The vertical column resembles in an end sectional view the backbone or spinal support of a schoolboy's kite.

A concession to operate two thousand automobile chairs at the World's Fair, St. Louis, has been granted to a company in St. Louis.

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CHAIN VS. WIRE CABLES IN THE NEW EAST RIVER BRIDGE.

It is quite possible to make too much of the controversy which has arisen over the decision of the Bridge Commissioner to use chain instead of wire cables for the latest East River bridge, known officially as the Manhattan Bridge. At the time when the present Bridge Commissioner went into office, plans of the bridge had been prepared, which called for a wire-cable structure of extremely unprepossessing appearance, having even less pretensions to architectural beauty than the Williamsburg Bridge, a little further up the East River, which is now nearing completion. There were two principal objections to the design; the first being, as mentioned, that of its inherent lack of beauty, and the second being the fact that the city was in most urgent need of the services of the bridge, and judging from the fact that the cables were to be of wire construction, it was probable, if the new East River Bridge was any criterion, that the completion of the new structure would be subject to serious delays. Moreover, it was realized that although there was no question of the stability or strength of the wire cable design, it was, nevertheless, of a type that did not embody the improved principles which mark the thoroughly up-to-date long-span bridge.

The broad distinction between the present eye-bar and the discarded wire-cable design lies in the different methods adopted for giving the stiffness to the bridge which is necessary to prevent deformation under moving loads. In the wire-cable type, such as the present Brooklyn Bridge and the Williamsburg Bridge, rigidity is afforded by a series of stiffening trusses which are worked into the floor system. These trusses are entirely distinct from the cables, and represent so much added dead load which the bridge must carry in order to supply that resistance to deformation which the cables entirely lack. Judged from the artistic standpoint, this is distinctly unfortunate, for the reason that although shallow trusses, such as those of the Brooklyn Bridge, conform very well from the point of balance and proportion with the light, thread-like cables above them, they are certain to prove, as they have done in this bridge, entirely too light for their duty. On the other hand, if these trusses are made of sufficient depth and weight to provide the necessary stiffness to the floor system, they become so heavy as to entirely destroy the harmonious appearance of the structure, and rob it of that grace and symmetry which should be a distinguishing characteristic of every suspension bridge. This effect will be noticeable at once to anyone who approaches the present Williamsburg Bridge by water. Whatever pretensions to good looks this bridge may have had in the earlier stages of its construction, they have gradually disappeared as the heavy mass of the deep, 50-foot stiffening truss was built in place from anchorage to anchorage. Although there is no doubt that the proportion between the cables and the mass of floor system is correct for the work that it has to do, there is no denying that, looked at from the standpoint of architectural effect, the result is exceedingly harsh and dissatisfying.

In the new design, which possesses every element of architectural beauty, it has been shown that by making the cables share in the work of giving proper vertical stiffness to the floor system, it is possible to give a great suspension bridge such as this an appearance of harmonious proportion without doing any violence to good engineering practice, or making use of superfluous material worked in merely for architectural effect. In the new design, the cables are not merely strung over the towers from anchorage to anchorage to act as a flexible support to a flexible floor that must be heavily stiffened before it is practicable to send a live load over it, but each of these cables is made to act as the top chord of a stiffening truss which gives the necessary rigidity to the bridge. Here, at once, there is an obvious economy of material, and the unpleasing contrast between the thread-like cables and the ponderous stiffening trusses is avoided, the two being blended in one and producing a most harmonious and handsome effect. Of course, the steel wire possesses, unit for unit, a greater strength than the nickel-steel chain cable; that is to say, for the same strength of cable, there will be less weight in the wire than in the chain, and for this reason it would be desirable to use a trussed wire cable, in preference to trussed eyebars. This, however, cannot be done, for the reason that it would be impracticable to make satisfactory connections between the web members of such a truss and the wire cable. Were it not for this difficulty, trussed wire cables such as were proposed for the Hudson River Bridge might be employed.

The objections urged by the small minority of experts who are attacking the proposed eye-bar cable—most of whom, by the way, are identified with wire cable-making interests, either as owners or employes—are more formidable on paper than in reality. The eye-bar cable is certainly as durable as one of wire. That there is no wear of the pins in the eyes is proved by the perfect state of preservation of some long-span European chain bridges, built long ago, notably the one across the Menai Straits in England, which after nearly a century of existence is in perfect condition. As a matter of fact, there is no rotation of the eye-bars about the pins, frictional resistance to turning being greater than the resistance to flexure in the body of the bars themselves; that is to say, the changes of curvature in the chain are taken care of by the flexure of the eye-bars, the chain from tower to tower acting as a continuous piece of metal. This is proved by the fact that the paint at the pins shows no signs whatever of cracking.

Not only is the eyebar design greatly superior in appearance, but it can be unquestionably built more rapidly than a wire-cable bridge. The New York public wants this bridge very badly. It is now smarting under the inconvenience of the unpardonable delay in the construction of the new East River Bridge, a large part of which delay was due to the slowness of the construction of the wire cable. It is stated by the Bridge Commissioner that his design for the new bridge can be built within three years' time, which is several years less than the East River Bridge has taken to grow even to its present incompleted state. It is true that the eyebar bridge may possibly cost something more than a wire-cable structure; but the difference is slight, and certainly not so great as to compare with the enormous inconvenience to which New York city would be subjected by any delay in the opening of this greatly-needed thoroughfare. There are some things that cannot be estimated in terms of dollars and cents; and anyone who stands during the rush hours at the terminals of the Brooklyn Bridge and watches the daily riot there, will feel that a year or two saved in the opening of another bridge in its near neighborhood, is well worth any slight increase in the cost of its construction.

COMBS AND CIGAR HOLDERS MADE OF MILK.

At the Hygienic Milk Supply (Hygienische Milchversorgung) Exhibition, which was lately held at Hamburg, the Vereinigten Gummiwaren-Fabriken of Harburg and Vienna exhibited a number of objects which seemingly had nothing whatsoever to do with hygienic milk supply. There were shown, nicely arranged in glass boxes, combs seemingly made of horn; cigar holders with amber-colored mouthpieces; knives and forks with handles similar in appearance to ebony; ferrules for umbrellas and sticks, and balls, rings, chess figures, dominoes, etc.; also a small table with an inlaid marble slab, and finally a number of thick slabs and staves with every imaginable variation of marble colors, but of considerably less weight than real marble. These objects were made of "galalith"—i. e., milk stone.

Skimmed milk, in spite of its many valuable qualities, has so far been little used; it contains a considerable portion of nutritious matter, i. e., 1 liter (1.05 quarts) of skimmed milk is of about equal value to a quarter of a pound of meat. It is by far too little appreciated as a cheap food for the people, hence what the German peasant cannot sell to milk-sugar factories or use for the manufacture of cheese is given to cattle and pigs as food. The principal albumenoid substance of skimmed milk, the casein, is the raw material out of which the new product galalith is manufactured. More than fifteen years ago the idea was originated to manufacture various articles like buttons, handles, ornamental plates, and colored pencils out of casein. The inventor took out a patent for a manufacturing process, which is described as follows:

Fresh casein—i. e., ordinary or dried curds—was dissolved in hot soap water; to this solution the required coloring ingredients and a metallic salt were added, and a firm substance consisting of casein and metallic soap was produced, which, by drying and pressing into molds, could be given any desired shape. It is to be supposed that the inventor had found out by continued trials that casein by addition of a metallic salt becomes brittle and softens easily in water. With a view to counteracting this latter drawback soap was added, but the articles produced thus were soft and brittle, and the invention was not a success. The chemical factory of Schering at Berlin then invented a process, the idea of which was to make casein insoluble by the addition of formaldehyde, but the disadvantage of this invention was that the articles produced distended considerably in water.

The inventors of galalith succeeded, after many troublesome trials, in doing away with the deficiencies of former methods and in using the good that was in the former ones, for the working out of an entirely new process. Their first aim was to make an insoluble union of casein by the addition of salts and acids. The substance thus obtained was dephlegmated and dried, and, finally, by the addition of formaldehyde, the galalith was obtained. To produce, for instance, a material similar to ebony, which could be used for handles of table knives, they proceeded as follows: Dissolved casein was given a dark color by the addition of soot and, with the help of a metallic salt (acetate of lead), a slate-colored precipitate was obtained. This was mixed with water and the thin pap filled into a cloth stretched over a frame. The water becoming absorbed by the cloth, the pap contracted into a uniform, firm, and dark mass; this was placed in a solution of formaldehyde and, after being dried, a product resulted which in luster and color was equal to ebony. In this way a raw material is produced which the inventors have protected by numerous patents.

An advantage of the new product as compared with celluloid is the fact that it does not ignite so easily and is entirely odorless. Trials have proved that even when kept for weeks in water, it does not distend more than the best quality of buffalo horn; after one month it had not soaked in more than 20 per cent of water. Of late, trials have been made to produce, by the addition of vegetable oils, an insulating material for electrotechnical purposes.

THE "AKOUPHONE"—A CORRECTION.

In the issue of the SCIENTIFIC AMERICAN of June 13, 1903, appears an erroneous statement, in an article entitled: "New Instruments for Enabling the Deaf to Hear," to the effect that a similar instrument previously invented and used called the "akouphone" had been abandoned.

We learn from Mr. K. B. Conger, president of the Akouphone Company, of No. 36 East 20th Street, in this city, that such is not the case; but that though the "akouphone" had its inception in undeveloped inventions of Mr. Miller Reese Hutchinson, the instruments made under these inventions were quite unsatisfactory. He stated the present perfected instrument, now made and sold under the name "akouphone," is most effective and reliable, and is the result of long and careful experimentation by the company's present manager and electrical expert, Mr. Morgan D. Evans. We are informed also that the instrument is now in extensive and successful use, not only in this country, but in several foreign countries.

The principle of the instrument is similar to a telephone, but in one particular point it differs; it is not necessary to talk directly into the receiver. The receiver of the "akouphone" is especially constructed for distant sounds, and transmits them to the ear with greater power than the telephone, which is spoken directly into. The voice of a speaker using an ordinary tone of conversation at a distance is reproduced in the "akouphone" earpiece, thereby giving absolutely the same effect as if the speaker were talking loudly directly into the ear of the deaf person.

DEATH OF CHARLES C. MARTIN.

Charles C. Martin, consulting engineer of the Division of Bridges of New York city, died suddenly at Far Rockaway, in his seventy-second year. Mr. Martin's name is most closely associated with the Brooklyn Bridge, the construction of which was carried on under his supervision. He cared for the structure almost up to the day of his death.

Mr. Martin's first work was on the conduits of the Brooklyn Waterworks. Later he became rodman in the old Trenton Locomotive Works and was advanced to the position of superintendent. The company sent him in 1860 to Savannah, Ga., to construct a railroad bridge across the Savannah River. It was while he was engaged in this work that he sank the first pneumatic cylinder ever used in this country. During the war of the rebellion, Mr. Martin built several bridges, superintended the manufacture of guns, and made boiler experiments for the government at the Brooklyn navy yard. After the war he became chief engineer of Prospect Park and laid out its drainage system. On the appointment of Washington A. Roebling as chief engineer of the Brooklyn Bridge, Mr. Martin was made principal assistant, and was put in charge of the construction work. When Mr. Roebling resigned in 1883, he became chief engineer. In 1902 he was made consulting engineer.

NEW TESTS BY DR. WILEY.

In addition to his tests of adulterated foods, Dr. Wiley will begin a series of experiments for the purpose of showing the effect of pure and of adulterated tobacco upon the digestive apparatus of the human system. It is Dr. Wiley's intention to take men who are regular smokers and to ascertain their physical condition as to heart action, breathing, and digestion, while continuing the use of tobacco under normal conditions, and then to have them suddenly cease the use of tobacco entirely.

THE DEATH OF EUGENE VANDERPOOL.

Eugene Vanderpool, president of the International Gas Light Association and of the American Gas Light Association, recently died in Newark at the age of fifty-nine. He was a graduate of Princeton and of the Troy Polytechnic School. He was known the world over as an able gas engineer.

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AN IMPROVED STATIC ELECTRIC MACHINE.

Our illustrations show the general appearance of a static electric machine that has been perfected by Mr. Henry B. Todd, of Meriden, Conn., and that will be found most useful by physicians and others who need a reliable machine for giving electrical treatment and for X-ray work. The machine is an improvement over the Holtz or Toepler style of machine, both in details of construction and in immunity from being affected by damp weather. It is absolutely self-exciting, requiring no separate exciter or starter, and can be depended on for practically the same current under all weather conditions.

With all other static machines now on the market, the use of chloride of calcium or some other moisture absorbent is obligatory during damp weather, especially the dog-day weather of July and August.

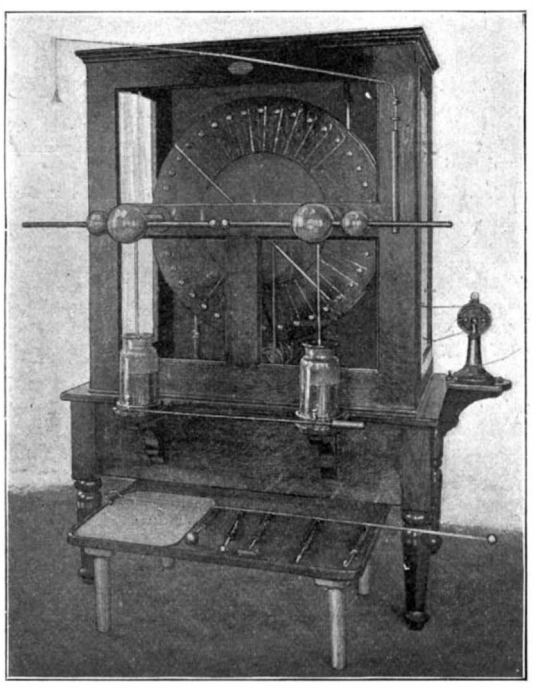
Two seasons' use of the Todd machine on the New England coast during these humid summer months has demonstrated this to be unnecessary, the moisture-defying qualities of the machine, as well as its increased powerfulness, seeming to be due to the novel form of construction, upon which Mr. Todd has secured a patent.

The new form of construction used consists in making all the plates revolve, and in placing alongside of each plate having sectors, a plain plate that revolves with it. In the machine shown, for example, the two outside plates each have sectors, or raised buttons, for the exciting brushes to rub against. These two plates revolve in opposite directions, while the inside plain plate adjoining each revolves with it. By the addition of the plain plates, the capacity of the machine in current it will deliver is increased four fold. This current is collected from the plates in the regular way by combs within the casing and in close proximity to them, the combs being on rods that pass through heavy hard rubber insulating bushings and join the two main rods carrying the balls in front.

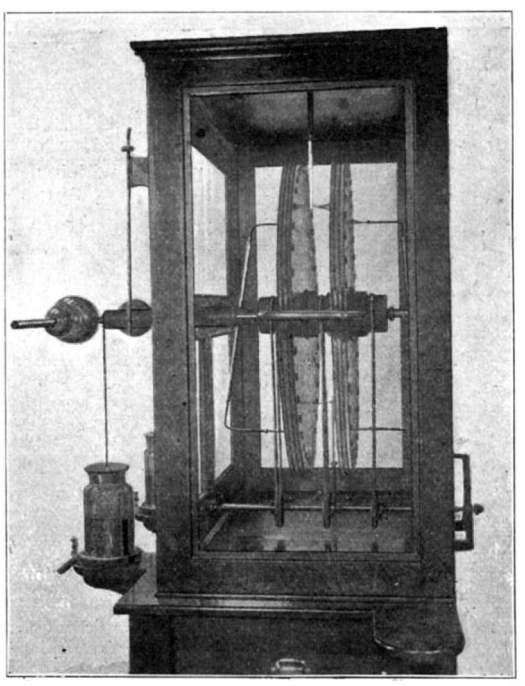
Leyden jars are connected to these rods in the usual manner.

The Todd machine is very substantially built and has several improvements in construction, such as the method of clamping the plates without danger of breaking or loosening after they are once adjusted; the attaching of the conductors to the combs by friction, so that accidental displacement of the sliding electrodes can be instantly adjusted; and the perfecting of all minor details that is so essential to thorough efficiency.

By revolving both plates in opposite directions, the surface speed is practically doubled, so that all the advantages claimed for fast speed in X-ray work are secured, while at the same time both the wear and vibration of the high speeds ordinarily employed are reduced one half, thus conducing to long life of the machine and its comparatively noiseless operation. The machines can be run by a small electric or water motor, or by hand power. They are manufactured by the Electric Manufacturing Company, of Meriden, Conn., and are made in a variety of sizes suitable for physicians, hospitals, sanitariums, and family use.



Front View, Showing Leyden Jars, Electrical Massage Instruments on Table, and Motor for Driving at the Side.



Side View, Showing Four Pairs of Plates with Their Exciting Brushes.

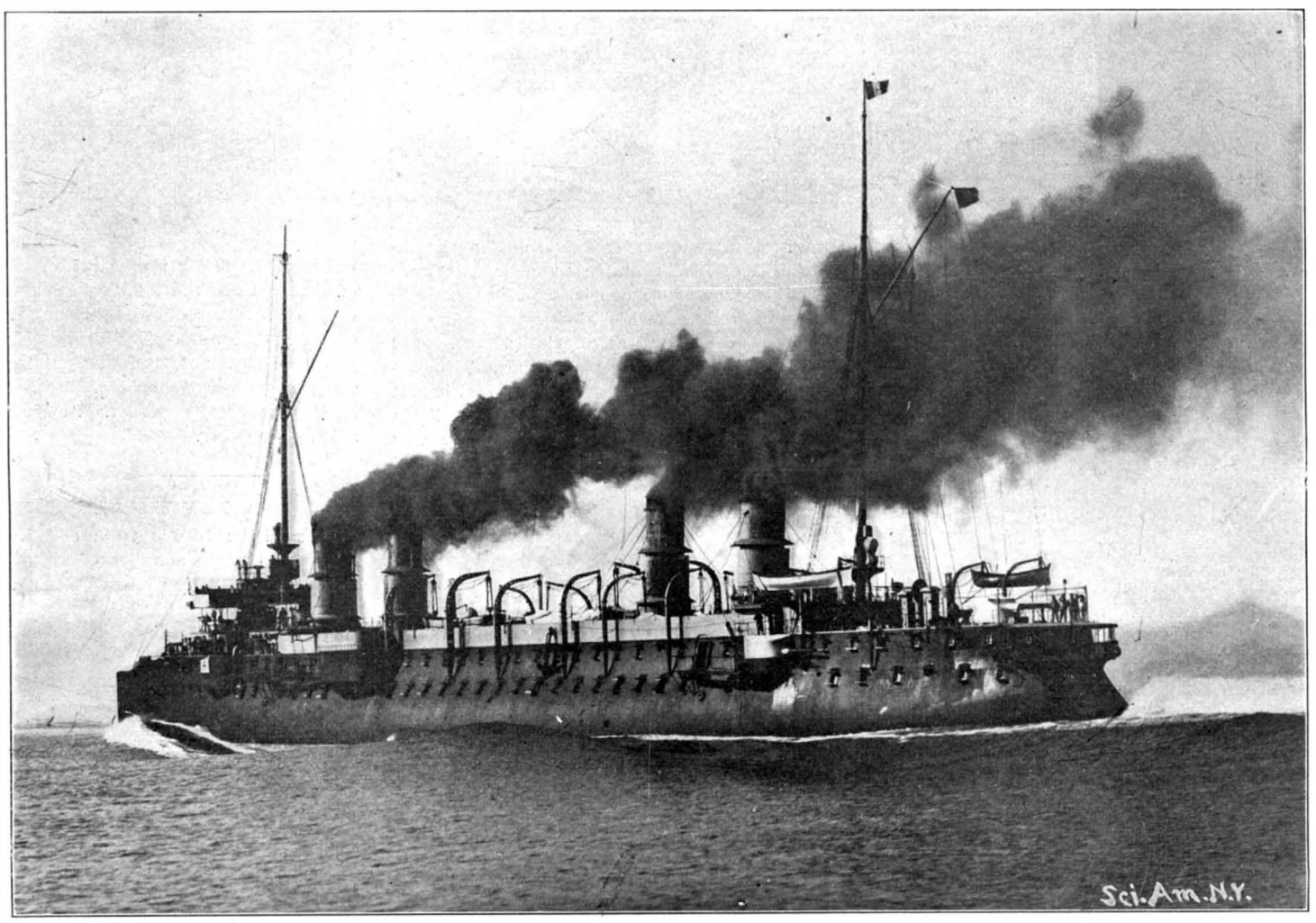
AN IMPROVED STATIC ELECTRIC MACHINE.

FRENCH COMMERCE-DESTROYER "GUICHEN."

The French naval architects have earned a great reputation by the almost uniform success which has marked the speed trials of the fast cruisers and commerce destroyers designed during the past decade for the French navy. There is no body of naval architects that has gone so deeply into the theoretical side of the question of ship models and propeller designs in relation to high speed, and in the past four or five years particularly they have succeeded in obtaining, almost without exception, higher speeds in their cruisers and commerce-destroyers than were called for by the contract. The accompanying illustration is from a photograph of the fast commerce-destroyer "Guichen," which on her trial developed a maximum speed of 23.55 knots per hour. The vessel has those well-defined characteristics of the French cruisers by which they can be recognized at first glance and distinguished from those of any other navy, the most conspicuous difference being the extreme tumble-home of the top-sides, which, instead of extending vertically from the waterline to the upper deck, as in our own vessels, curves sharply inboard from the waterline, and then rounds up to the level of the upper deck with a reverse curve. This form has the advantage of reducing top weights and the disadvantage of greatly reducing the berthing accommodations for the ship's crew. In only one vessel, the "Brooklyn," has our Navy Department shown any disposition to imitate the French practice, and while the latter is a very successful ship and popular with the navy, it is not likely that we shall build another of her peculiar above-water form.

The "Guichen" has a length of 463 feet, a beam of 55 feet, and a draft of 27 feet. It will thus be seen that for a cruiser she is narrow in proportion to her length, and to this is to be attributed in some degree her remarkable speed. She is driven by three sets of four-cylinder, triple-expansion engines, one to each of the three propellers. Her boiler plant consists of thirty-six Lagrafel d'Allest boilers. The designed indicated horse power under natural draft was 14,500; and the designed full power was 24,000 horse power. On her trial, however, during a run under natural draft of twenty-four hours' duration, she indicated 18,500 horse power, and maintained an average speed of twenty knots an hour, and on a four hours' continuous trial under forced draft she indicated 25,455 horse power, which gave her a speed of 23.55 knots an hour. As the vessel was designed primarily as a commerce-destroyer, her armament is a light one relatively to her displacement. She carries two 45-caliber 6.4 inch rapid-fire guns on the upper deck, one forward and one aft, protected by gun shields. On the deck below she carries six 5.5 inch rapid-fire guns, which are mounted in casemates of 1½-inch armor. These are mounted one on either bow, one on either quarter, and one on each beam amidships. There are also ten 3-pounders, five 1-pounders, and two above-water torpedo tubes. The conning tower is protected with 6¼-inch armor, and the water-line protection consists of an armored deck 2½ inches in thickness which slopes from below the water-line at the sides to about 4½ feet above the water-line inboard. The deck also slopes forward and aft to the bow and stern. With this armored deck is associated a belt of cellulose worked along the sides of the ship at the water-line.

The day on which the high-speed trials of the "Guichen" took place the sea was perfectly calm and afforded an excellent opportunity to study the wave action of a vessel of this kind traveling at high speed. The photograph reproduced is particularly interesting as showing this wave action and illustrating the remarkable wake produced when three propellers are exerting, as in this case, a thrust of over 25,000 horse power.



Displacement, 8,277 tons. **Speed,** 23.5k nots. **Coal Supply,** 2,000 tons and liquid fuel. **Armor:** 2½-inch deck; 1½-inch casemates; 2-inch gun shields. **Armament:** Two 6.4-inch; six 5.5-inch; ten 3-pounders; five 1-pounders; two above-water torpedo tubes. **Complement,** 625.

FAST FRENCH COMMERCE-DESTROYER "GUICHEN."

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THE GORDON BENNETT AUTOMOBILE CUP RACE.

PREPARED SPECIALLY FOR THE SCIENTIFIC AMERICAN BY OUR CORRESPONDENT IN IRELAND.

The great International Motor Car Race of 1903 is the first—and very possibly it may be the last—automobile contest on common roads ever held on British soil. Next year it will have to be held in Germany, but it is quite possible, in view of the tremendous horse power of the modern racing car, and the ever-increasing danger, both to the competitors and to the suppose that 60, 80, or 100 horse power cars will be produced for ordinary driving next season.

Before describing the race, a word may be said respecting the history of the "Gordon Bennett Cup."

In 1899, Mr. James Gordon Bennett, the proprietor of the New York Herald, instituted an International Cup which is to the automobile world what the "America" Cup is to the yachting world.

The first race was run in 1900. The course was from Paris to Lyons, 353¾ miles. France, Belgium, and America each competed, and the winner was a Frenchman, M. Charron, who covered the course in 9 hours, 9 minutes, making an average of 32½ miles per hour. He drove a 20 horse power Panhard machine, which weighed 2,100 pounds, and whose highest speed was about 53 miles an hour. The other competitors representing France were Giradot and De Knyff.

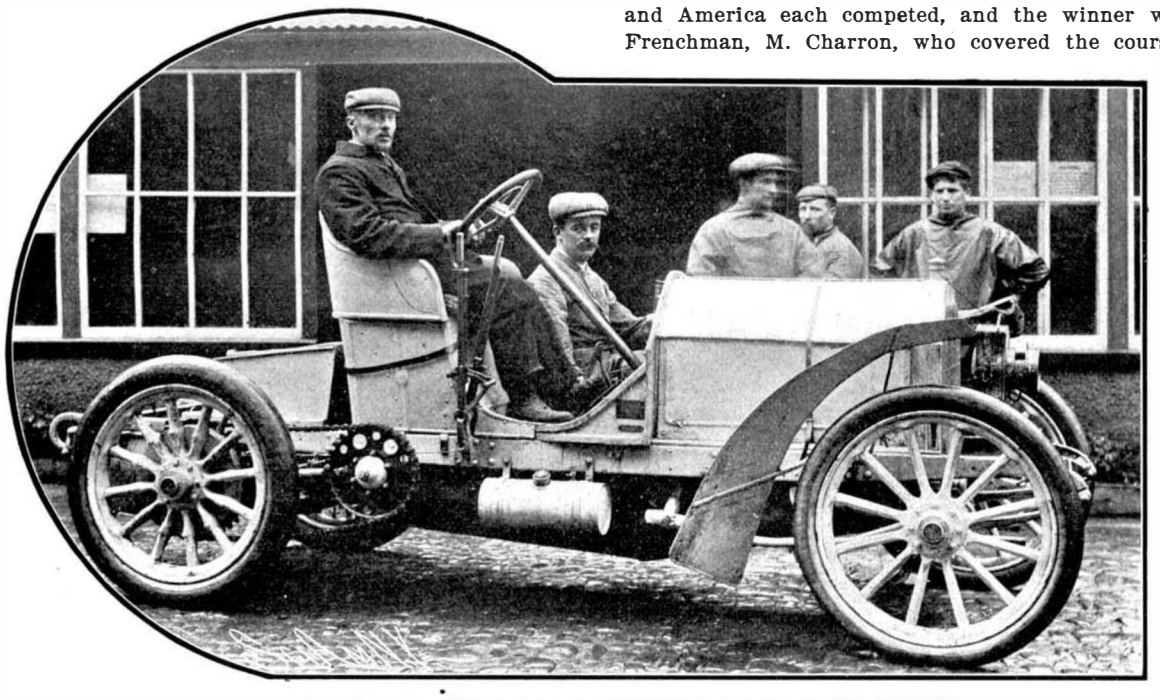
The representative of America was Mr. Winton, who drove a Winton car and abandoned the race at Chevreuse, where he broke one of his front wheels.

Belgium was represented by M. Jenatzy, the winner of the cup on July 2 last, whose car upset near Châteaufort owing to the bursting of a tire.

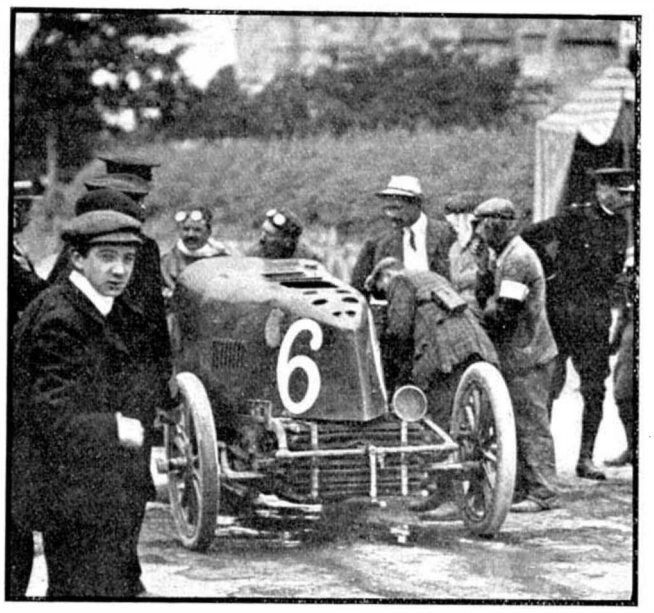
The second contest took place on March 29, 1901, simultaneously with the Paris-Bordeaux race, and over a course 328 miles in length. It was won by M. Giradot, who drove a 40 horse power Panhard with Centaure motor, the highest speed of which on a level road was about 60 miles an hour. M. Giradot covered the distance in 8 hours, 47 minutes, 39 seconds, his average working out at 37 miles an hour. The leather of his clutch became completely worn out at Tours, and here he had to remove the change-speed gear in order to renew it. Although this took 2½ hours, M. Giradot won with ease.

The other Frenchmen were M. Levegh on a 60 horse power Mors, and M. Charron on a Panhard. The former broke his bevel driving gear at Sainte Meure, and the latter broke all his inlet valves.

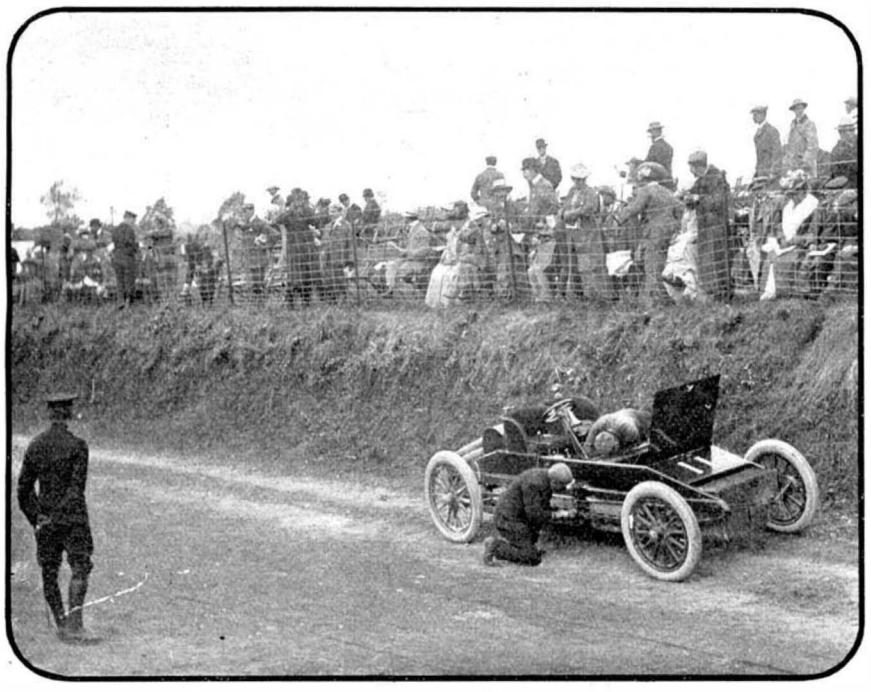
The only other competitor who entered was Mr. S. F. Edge, representing the United Kingdom. He drove a 50 horse power Napier car. He could not race for



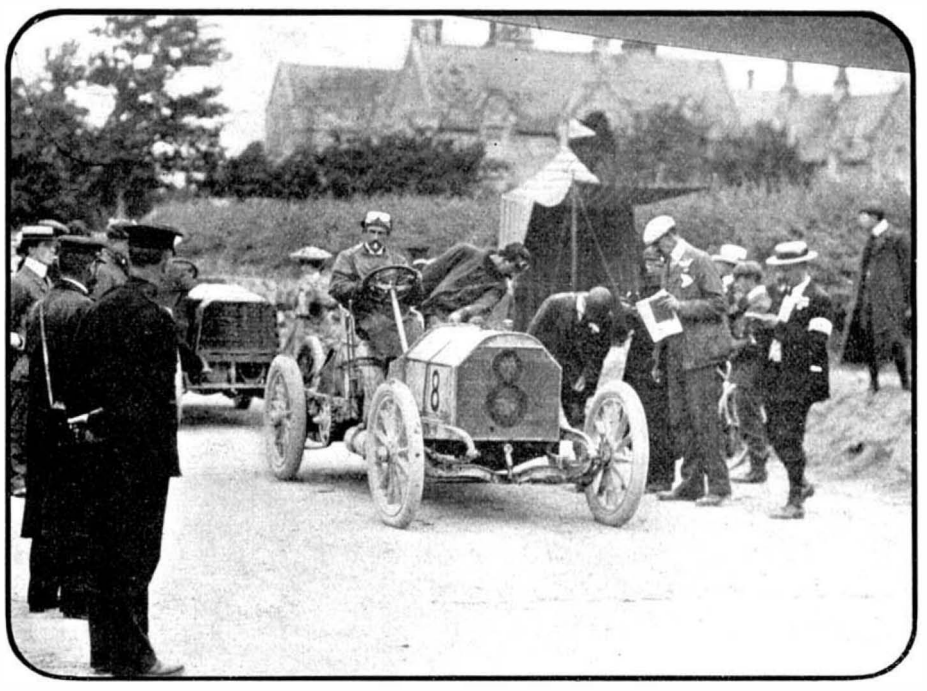
Jenatzy, the Winner, on Mr. Clarence Gray Dinsmore's Mercedes.



Gabriel on a Mors Car at the Athy Control.

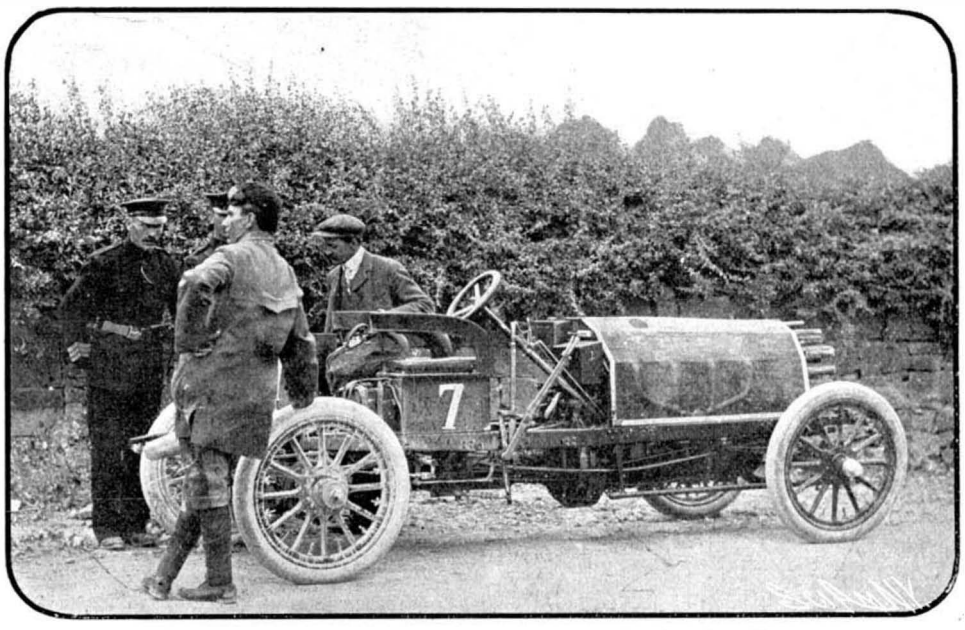


Mr. Winton Repairing His Car, After His Failure to Start.



Baron de Caters at Athy Control.

Foxhall Keene on His Mercedes.



Mr. Mooers in Athy, After the Accident to His Peerless Car.

SOME OF THE CONTESTANTS IN THE RACE FOR THE GORDON BENNETT TROPHY.

sightseers when the races are held on public highways, that the races of the future will be run on special tracks.

Motor contests have been of great value in stimulating the automobile industry, but it is doubtful if future races would result in any very important gain to the manufacturers. It used to be said that the racing cars of one year were the touring cars of the next. This was true some years back, but no one can

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the cup, as he could not get a British set of tires in time, his own having failed owing to the heaviness of the car.

By courtesy he was allowed to start first after the Gordon Bennett competitors in the Paris-Bordeaux race.

The third race, in 1902, was run over part of the Paris-Vienna route, between Paris and Innsbruck (387 miles). There were only four starters: Mr. Edge and MM. de Knyff, Giradot, and Fournier.

Mr. Edge, the winner, drove a 30 horse power Napier car and his time was 10 hours, 41 minutes, his average being 36 miles an hour.

M. Giradot drove a 60 horse power Charron, Giradot & Voigt car, but had to abandon the race at Bar-sur-Sâone owing to the leather of his clutch being worn.

Fournier drove an 80 horse power Mors racer, and had to abandon the race thirty miles before reaching Belfort, as his frame became bent and the shaft between the clutch and the gear broke.

M. de Knyff drove a 70 horse power Panhard, and succumbed when almost in sight of the winning post.

Fournier said afterward that he had some terrific racing on his Mors car against M. de Knyff's Panhard. The top speed of his car was about 75 miles an hour, and he made a record, doing one kilometer in 29 seconds.

The course for the race this year was chosen in Ireland on account of its being more sparsely settled than England or Scotland, and a special Act of Parliament was required before the race could be run.

The course chosen was in the shape of two loops, forming roughly a figure eight. The requisite distance—which has to be not more than 416 miles and not less than 344—could not be secured in one stretch, so the competitors had to traverse the course three times, thus allowing the onlookers to see the cars at least thrice from any one point. Those at the start and finish saw the cars pass no less than seven times.

The whole course once round was 103 miles, 740 yards, including the controls, i. e., the areas around villages and towns where the cars had to slow down, as well as at certain dangerous spots. The net racing distance was 92¾ miles. The course was covered three times, in addition to the western or larger circuit, once additional, making in all 368 miles, 780 yards.

There were seven controls in all. At Kilcullen crossroads, each driver was stopped for a moment and told his course; the other controls were at Castledermot, Carlow, Athy, Kildare, Monasterevan, and Stradbally. Here were head marshals, marshals, timekeepers and their assistants, starters, registrars, stewards, etc., making 161 officials in all.

A minimum time was fixed for the passage through the control according to its length, and each car was piloted by a bicyclist whom it was prohibited to pass. During the passage through the controls, the cars took on water, gasoline, and oil, as well as refreshment for the driver and mechanicians.

The first car was started at 7 A. M. on July 2, and this was a 100 horse power special Napier racer, driven by Mr. Edge, an illustration of which we give herewith. Taking the English cars first, it will be remembered that, as the result of the eliminating trials held recently on the Duke of Portland's private racing track at Welbeck, the Napier car proved its superiority over the "Star" car, the only other English car qualified to enter.

Mr. Edge had intended originally to drive one of the regular 1903 pattern, 35 horse power Napier cars. Quite at the last, however, he decided to use a new car with a more powerful motor specially designed by Mr. Napier for the race. This car is of much the same pattern as the other two Napier racers. The engine, however, is built higher, and the bonnet is oval instead of square.

The 35 horse power Napiers, driven by Messrs. Jarrott and Stocks, are of much the same type as those on which Mr. Edge won the cup last year. The machines are gear driven, with a direct drive on the top speed, and are built throughout with the idea of eliminating friction, so as to make excessive horse power unnecessary and at the same time enable the car to climb practically all hills at top speed. The wheels are 34 inches in diameter and the wheel base is 7½ feet. The system of spring suspension used is very simple, all the usual shackles being done away with. The clutch is self-contained, so that no end thrust is thrown on the engine or gear-box, and is of simpler form than before.

The weight limit of the racers was 2,204.6 pounds. The 110 horse power Napier weighed 1,985 pounds, while the 35 horse power cars weighed 1,970 pounds.

Chevalier René de Knyff, on a 70 horse power Panhard, was the second to start. He was sent off at 7:07 A. M., and was followed at 7-minute intervals by Percy Owen, on his Winton machine, and Camille Jenatzy on a Mercedes, representing America and Germany respectively. After them, two other sets consisting of one English, one French, one American, and one German machine were started, and the race was fairly under way. Winton was not able to start till 8:50.

Before the cars got away, the general favorites were Messrs. Edge and Jarrott, and Gabriel, the winner of the Paris-Madrid race. When Edge, after covering the 47 miles of the smaller loop, flashed past the starting point at 8:24, long before Winton had got away, the cheers from British throats were loud and long; but soon after this, trouble with punctures began (he is said to have used seven tires in the course of the day) and it was quite evident he had no chance of victory. With Jarrott and Stocks out of the race from accidents, the hopes of Great Britain were sadly shattered. As the day wore on, it was evident that the struggle would be between Jenatzy, De Knyff, and Henri Farman. Gabriel did not seem at home on his Mors car, and probably the winding roads puzzled him a good deal.

The American competitors had decidedly bad luck. Mr. Winton had trouble with bad gasoline containing paraffine, which stopped up the spraying nozzle of his carbureter, and cost him 48 minutes locating and remedying the trouble at the start. He gave up the race at an early stage. At the Athy control, Mr. Mooers lost a pin out of his change-speed gear and had to abandon the race.

Mr. Owen began well, and his neck-and-neck struggle with Jenatzy early in the day was one of the most exciting incidents of the contest. After this he never became dangerous, and finally quit after going twice around the course.

The close of the race was the most exciting incident of the day. De Knyff passed the winning post first at 5:34 P. M.. Then came Jenatzy at 5:36, then Farman at 5:39, and Gabriel at 6:20, while Edge was a very long way behind. Jenatzy was declared the winner, as he started 14 minutes after De Knyff.

The list of accidents and breakdowns was quite a long one, and only five out of twelve machines succeeded in finishing. The rear axle of Baron de Caters' Mercedes racer broke within 12 miles of the finish and he had to give up, while Mr. Foxhall Keene discovered signs of a breaking axle while passing through a control, and determined to retire.

Stocks mistook a turning and ran into a fence. His car was smashed and he was thrown over a wall, but neither he nor his chauffeur was much the worse for the mishap.

Jarrott came off with a broken collar bone; his steering gear went wrong, and his car, becoming uncontrollable, swerved and overturned, breaking in half as it did so. The Chevalier de Knyff took a wrong turn and ran into a fence, but he suffered no damage and lost hardly any time on this account. It was a wonder that the accidents were not more severe than they were, seeing that the cars frequently passed each other on the narrow roads.

The international character of the event lent of course an especial interest to the motor race, and the representatives of the four competing nations present naturally were keenly anxious that their country should bear off the cup.

The French team made the best showing as a whole, for it was the only one all three members of which finished. To it was awarded, therefore, the John Scott Montague prize for the best performance of any entire team.

The victory of the Mercedes car will undoubtedly give a great stimulus to the German automobile industry, though if road races are still to be permitted, it is quite certain that French, English, and American manufacturers will use every effort to turn out cars which shall successfully compete with the German racers.

The International Commission for the Gordon Bennett Cup Race, after sitting all day on July 3, formally awarded the trophy to the German Automobile Club.

The times, after allowing for control deductions, were as follows:

1. Jenatzy, Germany ....6 hrs. 39 min.
2. De Knyff, France.....6 hrs. 50 min. 40 sec.
3. Farman, France .....6 hrs. 51 min. 44 sec.
4. Gabriel, France .....7 hrs. 11 min. 33 sec.
5. Edge, United Kingdom. .9 hrs. 18 min. 48 sec.

Jenatzy's average speed for the 368⅛ miles worked out at 56¼ miles an hour.

This is the highest average ever made in any Gordon Bennett Cup Race. In 1900, M. Charron's time was 32½ miles an hour; in 1901, M. Giradot's was 37, and in 1902, Mr. Edge's was 36 miles an hour.

The elaborate arrangements made for the timing of the cars, both through the various controls and at the finish, are of considerable interest. The scheme was originated by Mr. R. E. Phillips, who has himself given the following particulars:

"As the cars were dispatched from the starting-point at a predetermined interval of time, the factors which determined the ultimate winner were (1) the sum total of the periods of time occupied in traversing the various controls, and (2) the periods of time which elapsed between the finish of the first and subsequent cars. The actual time occupied in completing the course, though of interest in showing the speed at which the cars have traveled, may be regarded as a negligible quantity so far as ascertaining the actual winner is concerned.

"Hitherto, in similar races, it has been the practice to time the arrival and departure of each car at and from a control, and arrive at the allowance to be made from the gross running time by a process of deduction; but experience has shown that it is impossible to get a large number of chronographs to synchronize after running for long periods, and that, as a consequence, errors accumulate.

"The system, therefore, which was employed in the Gordon Bennett race this year, provided that the time of each car in a control be checked and recorded on an independent watch, so that the timing of each car through a control should be a separate and independent observation. To do this, it was necessary to have twelve watches at each control, and, as there were seven controls, no less than eighty-four watches were required. To obtain this number of chronographs; with fly-back center-second hands and minute recorders correctly rated, seemed at first an insurmountable difficulty, but the well-known firm of chronograph manufacturers, Messrs. Stauffer, Son & Co., of London and Chaux-de-Fonds (Switzerland), stepped into the breach and loaned to the Club gratuitously, for the purpose of the race, the required number of chronographs.

"The *modus operandi* of timing the controls was as follows: At each control there were twelve watches and twelve small boxes to contain them. The timekeeper at the entrance to the control started one of the chronographs immediately a car arrived at the control and came to a state of rest in the space allowed. He then handed it to the head marshal of the control, who first satisfied himself that the chronograph was started, and then showed the same to the driver of the car and warned him of the time allowed for passing through the control. He then indorsed a duplicate card with the number of the car, and placed both the card and the watch in one of the boxes, and, having locked it with his master key, handed it to the cyclist allotted to pilot the car through the control.

"On reaching the end of the control, the cyclist gave the box containing the watch and the card to the starter, who, having opened it with the master key in his possession, again showed the watch to the driver of the car and told him roughly how much time remained before his time to depart. After having indorsed the duplicate card with the period of time allowed for the control, he placed one part of the card in the box on the car provided to receive such cards, and, at the expiration of the allotted time, gave the driver the signal to depart, at the same time pressing the button of the watch to stop the chronograph mechanism.

"The starter then placed the watch and the other half of the duplicate card in the box, locked the same, and returned it by the cyclist to the timekeeper at the entrance to the control. The timekeeper then examined the watch, and made a record of the period of time occupied in the control as shown by the minute recorder of the chronograph. After this, he set the hands of the chronograph back to zero, ready to be used for another car.

"Should the starter be unable—for official reasons—to get a car started out of his control at the termination of the allowed period, he allowed such additional time as might be necessary in periods of not less than one minute, and indorsed the two parts of the duplicate card with the actual time occupied in the control. At the entrance and exit of each control there was a large dial clock, so that the drivers could approximately ascertain for themselves the time of their arrival and departure. These clocks were all specially rated, so that they synchronized throughout the day.

"By this system it is impossible for errors to accumulate, and as there are no deductions to be made, errors possible in such calculations are also avoided. Further, as the starters at the exits of the controls read off the times for starting, any possible difference in the personal equation of a starter and a timekeeper is eliminated.

"As the time allowed for each control is, under normal conditions, constant, the starters only have to bear in mind one period of time, and, as a reminder, the minute-recording dials of all the watches employed in each control had a red mark on the dial denoting the period of time for that control.

"The start and finish of the race were timed by two independent systems. First, by three or more official timekeepers of the club, assisted by one or more official timekeepers of other competing clubs; and secondly, by my electrical timing apparatus, which was employed to time the arrival of the cars at the finishing point."

The Automobile Club of Great Britain and Ireland is to be congratulated on the precaution it took to insure the safety of the spectators.

Great credit is also due to the efforts of that splendid body of men, the Royal Irish Constabulary, and to the large bodies of police, soldiers, militia, volunteers, and others who guarded the whole of the course.

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A New Illuminating Material Discovered.

An important discovery has been made by the well-known German chemist Hermann Blau, of Bavaria. His method is to separate, by a process of rectification, the methane and hydrogen from the other constituents of oil gas, collecting the same in steel receivers subject to a pressure of 40 atmospheres, whereby he converts it into liquid form.

With the liquid gas made according to Blau's method, the cost is reduced to 6.3 pfennigs (1.5 cents), including freight.

This new illuminating material compares very favorably in cost with all others. The ease with which it can be handled and the beauty of its light should make it preferable where a lighting material is wanted as a substitute for petroleum, alcohol, or acetylene.

On the 24th of December, 1902, a test was made for the first time to produce the liquid gas. The trial showed how practical and very simple the process of preparation was. It has since been decided to erect an oil-gas furnace and to reconstruct the rectifying apparatus in accordance with the practical observations obtained by the experiments of last December.

A new test has recently been made and shows a most marked improvement and a remarkable productive power in every respect. It was also found that by the addition of a considerable amount of tar, which is in no wise detrimental, a beautiful yellow color was given to the gas.

A test tube filled with the liquid gas needed only the warmth of the hand to cause it to effervesce. It also effervesced when poured upon a metallic plate and on water. In the latter case a crust of ice was formed.

Its odor is pyroligneous aromatic. The concentration amounted to 537 grammes instead of 550 grammes per liter under a pressure of 40 atmospheres. The specific gravity, when in a gaseous state, was 1.26 (taking air at 1.0); absolute weight, 1.03.

The Approach of Borelly's Comet.

Since the time of its discovery, Borelly's comet has rapidly increased in brightness, until it is now easily visible as a star of the fourth magnitude. It should be easily detected one or two degrees southwest of the bright star Alpha Cygni. Its daily motion is about 5 degrees southwest. Prof. Perrine has computed the orbit of the comet, and finds that its nearest approach to the sun will occur on August 27, at a distance of about 3,000,000 miles. At present its distance from the sun is about 100,000,000 miles, and from the earth 20,000,000 miles. To the naked eye it will appear as a hazy patch of light. Photographs taken at the Lick Observatory indicate two prominent tails several degrees in length.

Prof. Langley's New Aerodrome.

According to newspaper reports, Prof. Langley's new aerodrome is to be tested somewhere on the Potomac River. The machine was recently towed on top of a large houseboat down-stream and anchored at tide water. Several years ago Prof. Langley demonstrated by means of a model the correctness of his principle of soaring flight. Ever since that time he has been ceaselessly engaged in the same work. In his investigations he was compelled to spend an appropriation of $50,000 by Congress, an allotment from the Army Board of Ordnance of $25,000, and a very large sum privately contributed. The successful trials made May 6 and November 28, 1896, have been fully described in the columns of the SCIENTIFIC AMERICAN SUPPLEMENT.

A Prize Offered to Stamp Out Boll Weevil.

Governor Lanham of Texas, on July 11, issued an official proclamation offering a reward of $50,000 to any person who would devise or discover a practical method or remedy for eradicating the cotton-boll weevil. The reward is to be paid out of the State treasury. The cotton belt of Texas has suffered much from the ravages of the boll weevil.

Large quantities of hydrogen being required for certain researches, it occurred to M. d'Arsonval that this hydrogen might be supplied from coal gas, of which hydrogen constitutes usually about 50 per cent, the remainder being principally methane. M. d'Arsonval has separated the hydrogen by condensing the methane by means of liquid air, using a very simple apparatus for the purpose. More recently he has dispensed with the use of liquid air entirely, and simply passes the gas, previously cooled to —80 deg. Centigrade, through a Linde liquid air machine, and in this way is able to obtain 3,500 cubic feet of hydrogen per hour at an expenditure of from 12 to 15 horse power. By a modification of the process, pure methane can be furnished as well as hydrogen. This is accomplished by dividing the process into two stages. In the first stage the gas is cooled to the temperature of solid CO_2, causing the condensation of CO_2 benzine and similar hydrocarbons. In the next stage the methane is condensed, and carries with it in suspension the carbon monoxide, which can be filtered off.

THE STUDY OF GASES AND METALS AT VERY HIGH TEMPERATURES.

BY PROF. JOHN TROWBRIDGE.

The electric furnace has told us much in regard to the behavior of the vapor of metals at extremely high temperatures. Probably these temperatures are much lower than that of the sun. Still, we are learning something of the chemical reactions which occur when such highly refractory substances as carbon and silicon are submitted to the heat of the electric arc in furnaces lined with infusible matter. The information which has been obtained is practically applied in great industries such as the manufacture of acetylene gas and of carborundum. Doubtless many more useful substances will result from the use of the heat of the electric arc. The electrical furnace, however, cannot be used to advantage in studying the reactions which occur, except through the final product. The spectroscope, for instance, cannot be used to study the extremely interesting spectra which arise when the vapor of metals is formed at high temperatures in closed chambers, such as are in commercial use.

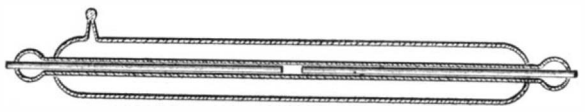

Fig. 1.

A scientific electric furnace, however, can be constructed as follows: Amorphous silica is made according to the method which I described in the SCIENTIFIC AMERICAN of March 28. It is then drawn into capillary tubes of suitable diameter; and electrodes of different metals are inserted in such capillaries. These electrodes, in my experiments, were one-half an inch apart, and, being four inches long, could be luted to the quartz capillary at this distance from the discharge end. The capillaries were then exhausted and filled with rarefied oxygen or hydrogen.

Fig. 1 represents one of these capillary spectrum tubes. The ends of the metallic terminals, between which powerful electric discharges were passed, were separated half an inch and sometimes less. When the discharges occurred between easily volatilized metal terminals, such as cadmium, tin, calcium, the lines which are peculiar to the spectrum of these metals, when the spectrum is obtained between these terminals in air, are in some cases very much broadened. Certain lines are also reversed; that is, they appear dark instead of bright. This darkening is due to a reversal which occurs on the photographic plate, and is not due to any phenomenon in the furnace.

In order to study these spectra a peculiar camera was employed which allowed the spectra produced by successive electric discharges to be obtained on the same photographic plate. This is desirable in order that the photographs can be subjected to the same development. Fig. 2 shows a set of spectra of what are supposed to be the lines peculiar to silicon. The spectra were obtained by electric discharges from a large glass condenser of .3 microfarad capacity charged to 20,000 volts by a storage battery. The discharges run from 1 to 5 and the photographs are seen to increase in brightness progressively, but not proportionally. It is interesting to notice no satisfactory estimate of the intensity of light can be made by photography. A photographic photometer is not reliable. In Fig. 2 we see reversed lines and also bright lines. One of the reversed lines occurs on a broad bright band which extends more in one direction with reference to the dark line than in the other direction, that is, more toward the red end of the spectrum.

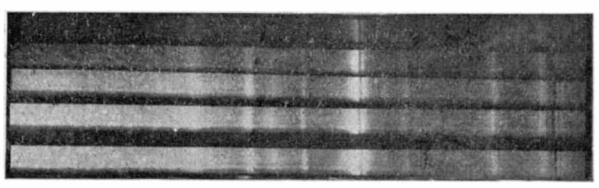

Fig. 2.

When iron terminals were employed in the capillaries no iron lines were obtained, even when the distance between these terminals was only a quarter of an inch. This was the case in rarefied hydrogen and rarefied air. In air at atmospheric pressure a vivid iron spectrum was obtained. This experiment throws doubt on some of the conclusions which have been entertained in regard to types of stars—types which have been supposed to indicate age and composition. The experiment shows that certain metals or gases may be present; but their presence may be masked by the reactions which occur at high temperatures.

The method of taking successive photographs of gases on the same photographic plate with known amounts of electrical energy is, I am convinced, the proper method to be pursued in studying the spectra of gases and of the vapor of metals. By this method one can compare the effect of increasing electromotive force in breaking up combinations of gases and forming new combinations. One of the most striking illustrations of this exhibition of change of combination is to be found in the case of water vapor introduced into a tube containing rarefied air and a trace of carbonic acid. With comparatively feeble amounts of electrical energy the peculiar bands due to hydrocarbons are obtained; as the electrical energy increases, these bands break up, and an entirely new spectrum appears, with no trace of the bands of hydrocarbons, or, indeed, no trace of hydrocarbons, although one knows that hydrocarbons are present.

In this case we have increased the temperature and have masked the presence of a compound. In the previous case we have kept the temperature the same and have brought different substances of different melting or vaporization points together in our scientific furnace. Electro-chemistry will gain much from the study of the spectra of gases and metals obtained with definite amounts of electrical energy.

Harvard University.

The Results of the International Kite-Flying Contest.

The international kite-flying contest arranged under the auspices of the Aeronautical Society of Great Britain was carried out on June 25 upon the Sussex Downs, near Worthing, and was attended with but mediocre success, a result due to the paucity in the number of the competing apparatus and the atmospheric conditions. The primary object of the competition was to encourage the utilization of kites as a means of obtaining meteorological knowledge of the higher regions of the atmosphere, and as a scheme for solving aerial navigation or at any rate the obtaining of some valuable data which might prove useful in achieving flight, and the best type of kites adaptable for this purpose. The Aeronautical Society had prepared a silver medal to be presented to the inventor of the kite which in the opinion of the jury appointed for the purpose, proved the most efficient, the only stipulation being that the kite qualifying for the award must exceed a minimum height of 3,000 feet and remain in the air for one hour. The jury was composed of Dr. William Shaw, F.R.S., secretary to the Royal Meteorological Council of Great Britain, Prof. C. V. Boys, F.R.S., Mr. E. P. Frost, Sir Hiram Maxim, Dr. Hugh Robert Mill, F.R.G.S., secretary to the Royal Meteorological Society, Mr. E. A. Reeves, curator of maps of the Royal Geographical Society, and Mr. Eric Bruce, secretary of the Aeronautical Society, so that the jury was representative of the scientists interested in the problem of flight and the value of kites for scientific investigation and research.

Eight competitors entered for the contest, including Major Baden-Powell, the president of the Aeronautical Society, who has been interested for several years past in the development of a kite capable of lifting a man, Mr. S. F. Cody, and Mr. L. Cody. Owing to a mishap which befell Major Baden-Powell's apparatus upon the ground just prior to the competition, he was unable to compete, while three other competitors failed to enter the contest, so that the number of contestants was reduced to four.

The most interesting apparatus was that of Mr. S. F. Cody, which was identical in design with that which he utilized for his experiments before the officials of the British Admiralty a short while ago.

The atmospheric conditions which reigned at the time were not the best adapted for successful kite flying owing to the capricious nature of the wind. Trouble was experienced in starting the kites, but once they were sent into the air a short distance above the ground, they became steadier in their motion. The heights of the kites during their hour in the air was not only determined by the length of the cable paid out, but they were further observed at their altitudes by means of theodolites. Two of these instruments were placed on the ground at different stations in telephonic communication with one another. One theodolite was in charge of Mr. J. E. Dallas and the other of Mr. N. F. Mackenzie, both of the Royal Engineering College, while the duties of computer were fulfilled by Mr. W. Mason, demonstrator at the engineering laboratory of King's College, London. Four observations were taken by each theodolite during the hour the kites were afloat in the air, and their results were checked by the computer with the length of cable paid out, so that absolute accuracy was assured. The results, however, were rather disappointing, since no remarkable altitudes were attained by the kites. The greatest height reached was only a little above 3,000 feet, notwithstanding that in one case 4,000 feet of cable was paid out. Owing to the fact that only four types of kites were flown the contest was not successful and did not afford much conclusive data as to the best type of kite adapted for the purposes for which the contest was arranged, but certainly the apparatus of Mr. S. F. Cody behaved the most efficiently.

The Swedish government has contributed $20,000 to the publication of Sven Hedin's Asiatic maps and two volumes of travels, to be translated into English.

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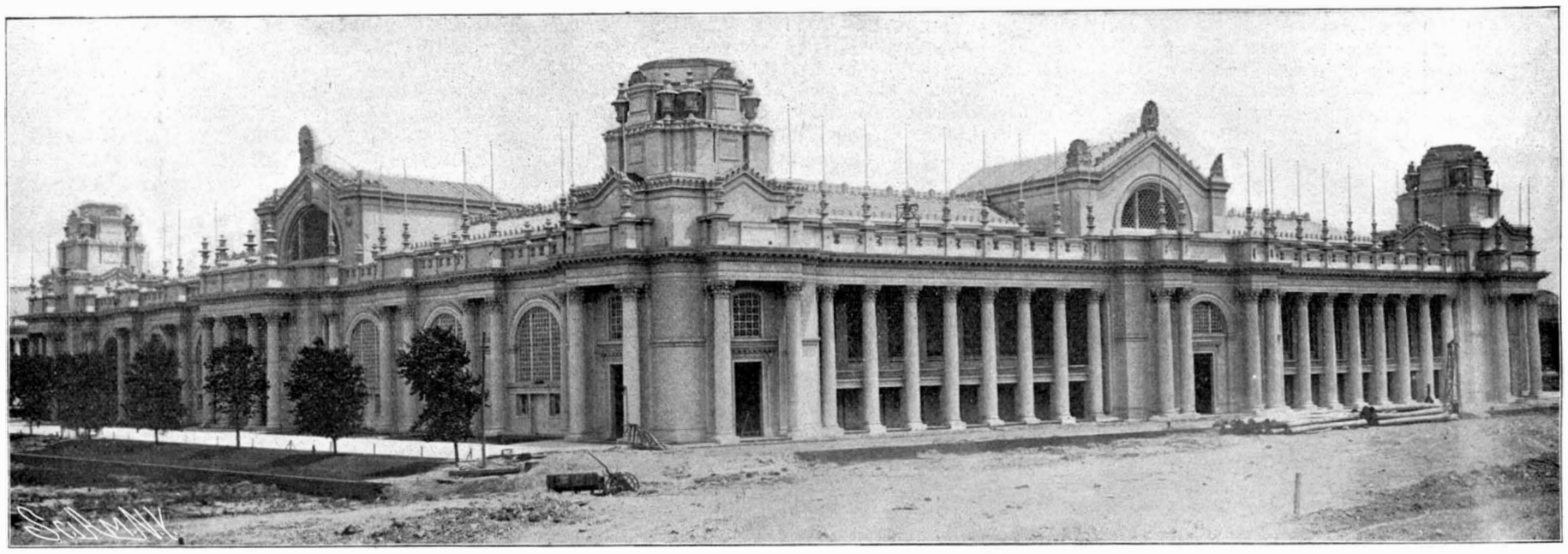
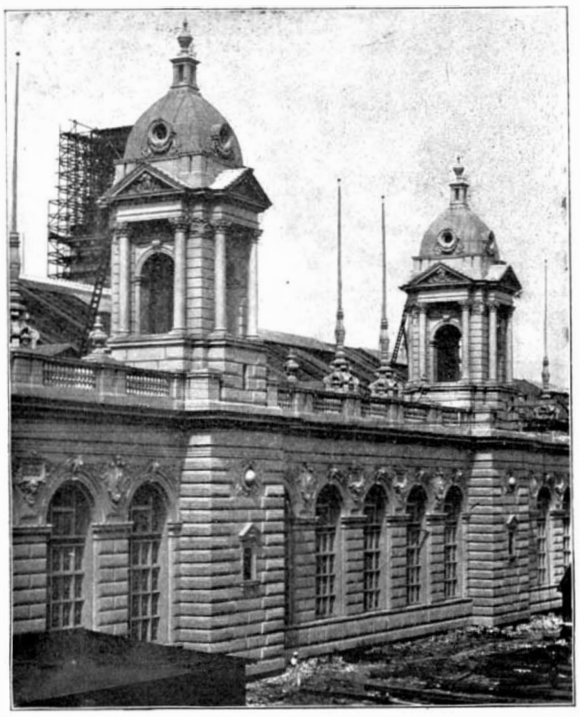
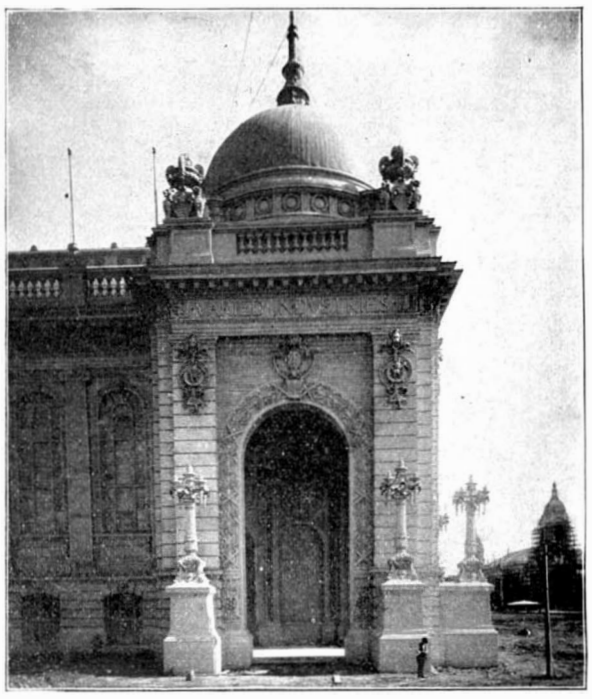


The Electricity Palace.



Finished Portion of Machinery Palace.

One of the Towers of the Palace of Varied Industries.



One of the Corner Entrances to the Palace of Varied Industries.

View from the Roof of the Palace of Varied Industries, showing the Palaces of Electricity, Education, Mines and Metallurgy, Manufactures and Liberal Arts, with the Lagoons and Walks.

THE PROGRESS OF THE LOUISIANA PURCHASE EXPOSITION.

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PROGRESS OF THE LOUISIANA PURCHASE EXPOSITION.

With but eight months more still to elapse before its opening day, the Louisiana Purchase Exposition can point to a more satisfactory record of accomplishment than ever before rewarded the efforts of world's fair builders. It is stated that the co-operation and official participation of more national governments than ever before took part in a universal exposition have been secured. The fair site of 1,240 acres is quite ample for the requirements of so vast an undertaking.

Five of the great exhibit palaces are now practically completed. The others, according to contract, must be finished within the year. So far advanced is the gigantic work of construction that it may be questioned if a single contractor will be found wanting when his contract time has expired. Even months before the opening day, the Exposition will be ready for at least a private inspection.

It has been said that the site of the Exposition grounds covers a space of 1,240 acres. This includes 60 acres recently leased. By this addition, the grounds have assumed the shape of a parallelogram, about a mile wide and nearly two miles long. As the result of this acquisition, a much more satisfactory arrangement of the terminal problem, the intramural railway scheme, gateway locations, and various other important matters that have been awaiting this consummation of the company's original plans, has been definitely decided upon.

The illustrations which are herewith presented tell better than words something of the architectural beauty of the Exposition. The staff work is probably the most exquisite that has ever been seen at a world's fair. The pictures representing one of the towers of the Varied Industries Palace, as well as a corner entrance to the same structure, admirably show something of the architectural refinements which will add to the charm of the Exposition. The work of the Electricity and Machinery palaces is likewise distinguished by the beauty of the staff work.

How imposing this long line of beautiful buildings must be can well be gathered from the illustration, which was taken at a point looking east along the main transverse avenue from the roof of the Varied Industries Palace. To the right may be seen the north façade of the Electricity Palace, the Education Palace with its magnificent colonnade, and the globe and obelisk of the Palace of Mines and Metallurgy in the distance. To the left appear the south façade of the Varied Industries Palace and the Manufactures and Liberal Arts palaces. In the great central space between these two files of structures are lagoons with terraces and borders of asphalt roadway.

No exposition has been more lavishly provided with sculpture in staff and bronze. Of the half-million dollars' worth of sculpture on the ground, one-fifth will represent material to remain forever on the permanent Art Palace. This work includes "Sculpture," by Daniel Chester French; "Painting," by Louis St. Gaudens; six figures, each by a different sculptor, representing art at various periods of human development; "Truth," by Philip Martini; "Nature," by Charles Grafly; "Inspiration," by Andrew O'Connor. All these will be marbles. Two griffins in hammered copper by Phinister Proctor, and twenty-two portrait madallions in white limestone to form a frieze under the cornice will complete the permanent decorations of the Art Palace.

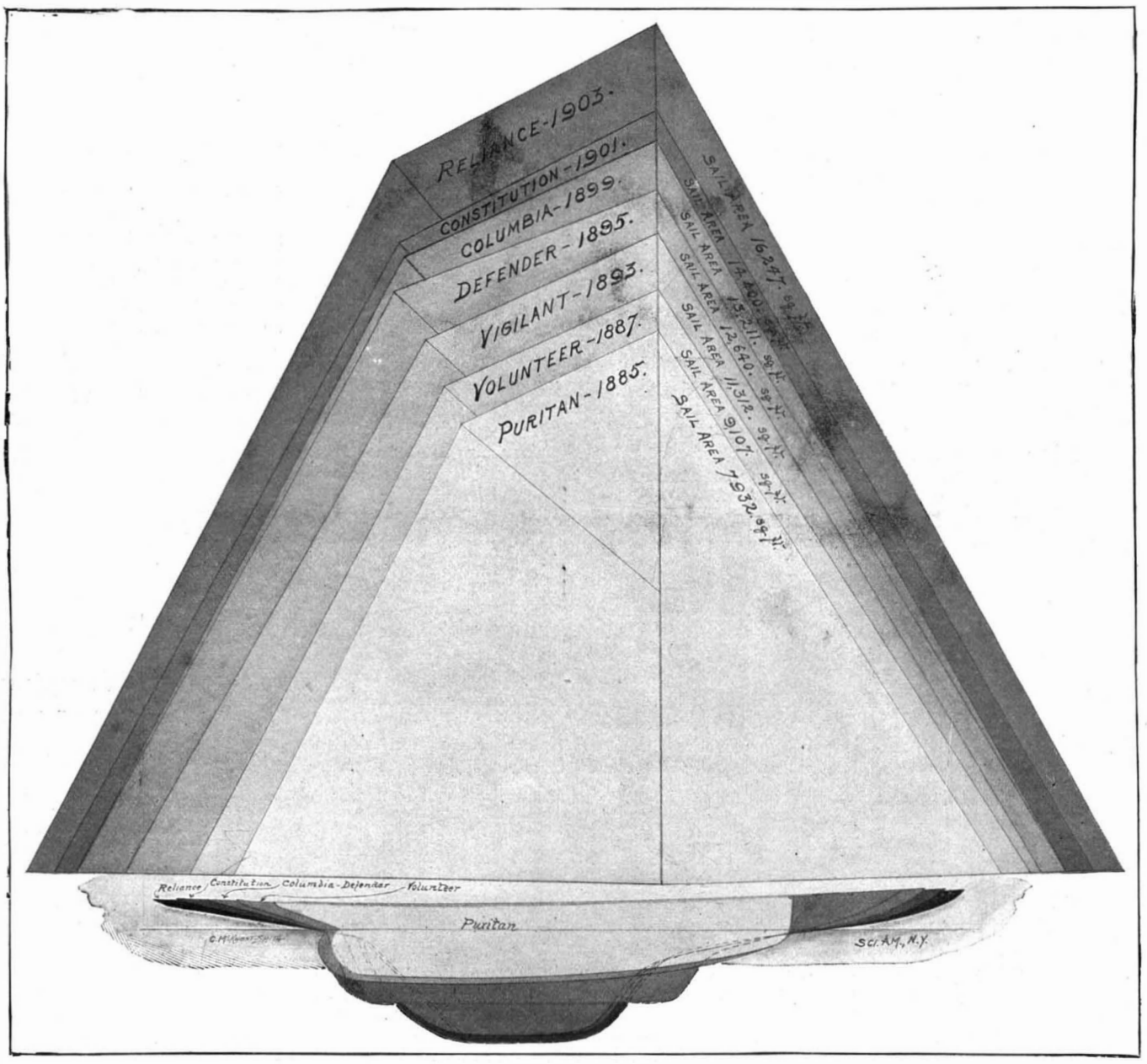
Every building on the grounds has received an allotment of sculpture as plentiful as this. As these sculptures are, however, in plaster instead of in bronze, they will be less expensive. All the architects have made provision in pediments and tympani, in spandrels over archways, on towering constructions, etc., for sculptural decoration. In the case of each building the sculptures will be symbolical of the exhibits which the structures will shelter.

The avenues of the Exposition, especially the central, 600-foot main avenue, will receive elaborate sculptural ornamentation. At the northern end of the main avenue will be a colossal group entitled "The Apotheosis of St. Louis," an equestrian statue by Charles H. Niehaus, of which the principal figure is the King of France, after whom the city of St. Louis is named. On the same axis with this group is the towering "Louisiana Purchase Monument" by Karl Bitter, which stands at the northern end of the main basin. Continuing, this axis passes through the center of the central cascade. All the boat landings in the main avenue are dressed out with animal groups. Four colossal animal groups by Solon H. Borglum, which will ornament the landing at the base of the Louisiana Purchase Monument, have passed the sketch stage. The architectural lines of all these monuments are designed by E. L. Masqueray, Chief of Design of the Exposition. The sculptor follows and carries out these lines in his figures and groups.

The climax of the sculpture is reached in the Cascade Garden and the Terrace of States. The three big cascades are masses of sculpture composed in obedience to a chaste architectural design. The main cascade, picturesquely named "Liberty Fountain," will be done by H. A. McNeil; the side cascades, symbolical respectively of the Atlantic and the Pacific oceans, will be done by Isidore Konti.

The Colonnade of States, the ribbon which ties together the three fine units of the composition, forms a frame for fourteen giant seated female figures, each symbolical of one of the States and Territories which have been carved out of the Louisiana Territory. The sculptors of these symbolical figures are all young men who have not yet achieved great reputations in their profession, but who, from their education and training, promise much.

Of the 250 sculptures that will hold a place in the Exposition, about thirty are portrait figures of inventors, discoverers, pioneers and explorers who have helped toward the development of the Louisiana Purchase Territory.



GROWTH OF THE AMERICAN CUP DEFENDER FROM CRUISER TO RACING MACHINE.

FROM CRUISER TO RACING MACHINE.

It is a curious fact that in the selfsame year in which the New York Yacht Club has adopted a new rule of measurement, designed to kill the racing freak and bring about a return to the wholesome, seaworthy, and comfortable yachts of fifteen years ago, the boat which they have built to defend the cup embodies in the most exaggerated degree all those undesirable features at which the new rule is aimed. It is also another curious fact that the challenging yacht conforms so much more closely to the new rule that if "Reliance" and "Shamrock III." were to be measured under this rule for the forthcoming races, the challenger would receive such a large time allowance that the return of the cup to the land of its nativity would be a foregone conclusion.

What might be called the scientific period of yacht designing in this country begins at about the period of the races of "Puritan" against "Genesta," in 1885. The growth to the exaggerated proportions of hull and sail plan shown in our accompanying diagram, is the logical and inevitable outcome of a rule of measurement altogether too broad and loose in its specifications. The only elements taxed in this rule are length on the water-line when on an even keel, and total sail area. To the competing designers the rule has said, "When your yachts are placed under the measurer's tape, if 90-footers they must not be over 90 feet long on the water-line, or if 70-footers not over 70 feet. If you choose to make them a little less than these lengths, their rating will be diminished accordingly. Outside of this restriction you may do just anything you please in modeling your hulls. They may be built of any material; they may be broad or narrow, shallow or deep; light and leakable as a wicker basket, or tight and heavy as an ironclad. As to the spread of sail, you may crack on just as much as you please; always with the understanding, however, that the more you carry the greater will be your racing measurement."

Now at the time of the "Puritan"-"Genesta" races, our yacht designers were beginning to emerge from the rule-of-thumb methods that characterized the days of the centerboard sloop and schooner, and were beginning, thanks to the victorious career of one or two imported deep-keel English cutters, to appreciate the value of outside lead as an element of sail-carrying power. Hence, the "Puritan" carried a large proportion of her 48 tons of lead ballast on the keel, and although she was marked by the shoalness of body and limited draft of the prevailing centerboard type, she was an extremely able sea boat, fast and comfortable, a wooden vessel of first-class construction, with a reasonable spread of sail which she was well able to carry in a blow, as was proved in that memorable race of twenty miles to leeward and back in half a gale of wind in which she won by a narrow margin over "Genesta." At the close of her racing career "Puritan" was changed from sloop to schooner-rig, and to-day she is doing service as a snug and comfortable cruiser. "Mayflower," the next cup defender, was an improved "Puritan," with 5 feet more length on the water-line and 8,824 square feet of sail; she was built of wood, and subsequently to her defense of the cup, she was turned into a comfortable cruiser. Her sail area is so nearly the same as that of her successor "Volunteer" that to avoid crowding our drawing her sail plan does not appear. "Volunteer" was designed by Burgess, the designer of "Puritan" and "Mayflower." She was the first of our large sloops

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to be built of steel. She was about 5 feet longer on the water-line than "Puritan," and carried a much larger sail plan, the boom being 84 feet as against 76½ feet of "Puritan," and the hoist to the topmast sheave being 111 feet as against 104 feet in the earlier boat. "Volunteer" also was a perfectly sound and wholesome vessel. Although her rig was a large one, she was well able to carry it; and like her predecessor she was changed after the cup races to a schooner, and is to-day in service as a successful cruiser. After a lapse of six years the New York Yacht Club was called upon once more to defend the cup, and on this occasion they went to Herreshoff, from whom they obtained two yachts, one of which, the "Colonia," was a keel boat, drawing 14 feet of water, built of steel, and carrying about 11,000 square feet of sail. She was a failure, for the reason that, like the "Navaho," another Herreshoff 90-footer of the same year, she was a poor boat on the wind.

The other yacht built for cup defense by Herreshoff was the "Vigilant," and in her we see the engineer attacking the problem of yacht design from his own particular point of view. Tobin bronze is used for the plating, hollow spars are experimented with, high-grade steel wire rope, blocks and other gear of extreme lightness, make their appearance in the spar and sail plans. As a consequence, although the "Vigilant" was only a few inches longer on the water-line than the "Volunteer," she carried over 2,000 square feet more sail. The boom was lengthened out to nigh upon 100 feet, while the hoist went up to 132 feet; and the sail spread to 11,312 square feet. "Vigilant" was to be the last of the centerboard yachts; for although she beat "Valkyrie II." in the series of races, she was beaten badly to windward by that boat in a stiff breeze; and subsequently, during a season in English waters, was beaten eleven times out of eighteen by the deep-keel cutter "Britannia," a sister boat to "Valkyrie II." That season's experience sealed the fate of the centerboard, and when the next challenge came, the Herreshoffs, intrusted with the contract of building a yacht to beat her, turned out to meet her the deep-keel cutter-sloop "Defender." "Vigilant" was the last of the cup defenders that was good for anything but cup defense. She has been changed into a yawl, and has proved to be an excellent cruiser under her reduced rig. In "Defender" we see the engineer still at work, reducing scantling and lightening up on construction even to the smallest detail. "Defender" was built of manganese bronze in the underbody, and aluminium in the topsides and framing. She carried a hollow steel mast, boom, and gaff. As a consequence, although she was a smaller boat than "Vigilant," having some 3 feet less beam, so great was the lightening of her weights, and the increase in stability due to lower ballast, that she carried over 1,000 feet more sail than the larger yacht, spreading 12,640 square feet. The main boom reached far over the taffrail, being 106 feet in length over all. The hoist was 7½ feet greater, and the forward measurement from mast to end of bowsprit had increased to over 73 feet.

THE DEVELOPMENT OF THE 90-FOOT RACING YACHT.

	Waterline Length.		Base of Fore Triangle.		Hoist from Boom to Topmast Sheave.		Boom.		Gaff.		Spinnaker Boom.		Total Sail Area.
	ft.	in.	ft.	in.	ft.	in	ft.	in.	ft.	in.	ft.	in.	sq. ft.
Puritan	81	1½	62	0	104	0	76	6	47	0	62	0	7,370
Mayflower	85	7	67	0	111	0	80	0	50	0	67	0	8,324
Volunteer	85	10	67	0	111	0	84	0	51	6	67	0	9,107
Vigilant	84	2	69	0	122	0	98	0	57	0	69	0	11,312
Defender	88	5⅝	73	3	129	5	106	0	64	10	73	4	12,640
Columbia	89	7⅛	73	3	138	5	107	0	64	10	73	4	13,211
Constitution	89	9	78	0	142	0	110	0	73	0	78	0	14,400
Reliance	90	0	84	0	155	0	115	0	72	0	84	0	16,247

When the "Defender" commenced her trials, it began to be evident that in the development of the 90-foot racing yacht the limit, not merely of convenience, but of actual safety, had been passed. The draft of 19 feet was in itself prohibitive of the use of the boat as a cruiser, since it shut her out from many of the harbors and desirable anchorages, while the experience of the boat in fresh to moderate breezes was marked by breakdowns which, on one occasion, came very near to being disastrous. In some races, when the wind breezed up, rivets were sheared off, and the climax came when in a bit of a squall the pull of the weather shrouds was so great that the mast came very near punching a hole for itself through the bottom of the boat. Herreshoff evidently had overlooked the fact that, in cutting into the keel until its forward edge was aft of the mast-step, he had left nothing but the light floor-plates and the frail plating to take the enormous downward thrust of the mast. Emergency repairs were at once made by carrying a pair of ½-inch by 8-inch steel straps from the foot of the mast up to a junction with the chain-plates at the deck. Trouble was also experienced in keeping the bowsprit from coming inboard; several of the frames of the boat broke at the turn of the garboards; and from first to last the extreme lightness of the craft was a source of unceasing anxiety to her owners.

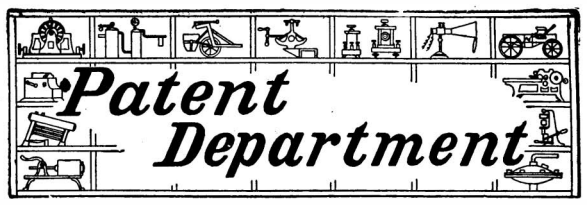
Four years later the Bristol yard turned out "Columbia," a yacht that embodied some of those features of hull and sail plan which experience in the smaller classes had shown to be conducive to high speed. She had a foot more depth, or 20 feet; her overhangs, forward and aft, were carried out until on a water-line length of 89 feet 7⅛ inches she had an overall length of about 50 per cent more, or 132 feet. Although a 90-footer when at anchor, she was a 115-footer when heeled to her sailing lines, the great increase in the overhangs being due to the effort to build the biggest possible boat on the arbitrary so-called 90-foot length. The enlargement of the sail plan was chiefly in the direction of greater hoist, the distance from main boom to topmast sheave being 138½ feet. The disastrous experience with "Defender" showed the absolute necessity of using more reliable materials in the hull, which was constructed of Tobin bronze plating on steel frames. The hull structure proved satisfactory, but the lightening up of the spars and standing rigging had been carried too far, as shown by the fact that in her trial races she carried away her mast.

Two years later, to meet "Shamrock II.," Herreshoff brought out the "Constitution," which differed in form from "Columbia" merely by an increase of one foot in the beam. The sail plan was greater than that of "Columbia" by about 1,200 square feet. The hoist had now increased to 142 feet, the boom to 110 feet, and the base of the forward triangle to 78 feet. "Constitution's" appearance is comparable only to that of "Defender" in the constant succession of breakdowns that have occurred; but with this distinction, however, that whereas "Defender's" trouble was in the hull, "Constitution's" has been up aloft. At different times she has carried away her mainmast, her topmast, and her gaff. Of the hull, however, it must be admitted that the system of belt-and-longitudinal framing adopted by Herreshoff has been eminently successful. Although it is probable that no large amount of weight is saved over the old system of framing, it is certain that weight for weight it is considerably stronger. "Constitution" proved so much of a disappointment, that it was realized this year that to defend the cup successfully some radical departure must be taken, and Herreshoff struck out most boldly in the direction of the "scow" type, which had proved so fast in the smaller classes of yachts. On a water-line of 90 feet, the new boat has a beam of over 26 feet, a draft of 20 feet, and an overall length of close upon 150 feet. Although she is a 90-footer at anchor, she is fully a 120-footer when heeled to a breeze; and to this fact is to be ascribed the astonishing sail-carrying power which she has shown, the area under the New York Yacht Club measurement being 16,247 square feet; and if changes are made, they will be rather in the direction of an increase than a reduction of sail plan. The growth of sail power in the last fifteen years may be summed up in the statement that on an increased water-line length of only 10 feet the "Reliance" of 1903 spreads over twice as much sail as did "Puritan" in 1885. In her we see unquestionably the highest possible development under the existing rule, and although the boat is an overgrown monstrosity as a sailing craft, she is certainly a great tribute to her builder, both as a naval architect and as a wonderfully resourceful and ingenious mechanic. She is the biggest, lightest constructed, most powerful, and probably the fastest yacht of her water-line length that ever was or ever will be constructed; and she possesses that dual quality, never before found in one and the same yacht, of being relatively just as fast in light as she is in strong winds.

The Current Supplement.

The current SUPPLEMENT, No. 1438, has for its front page article a very good description of the new Corinthian canal, which promises to be of much commercial importance to Greece. Admirable illustrations give one a good idea of the engineering difficulties which must have been encountered during the course of construction. Dr. Fleming's fourth paper on Hertzian wave telegraphy is presented. Prof. Wattiez gives a *résumé* of our present knowledge of radium. The Paris correspondent of the SCIENTIFIC AMERICAN presents the last installment of his series on some details of the Paris-Madrid automobile race. In the present installment, the Passy-Thellier and Clement voiturettes are described. The Antarctic experiences of the "Discovery" are given. The Atomic Theory and the Development of Modern Chemistry is the subject of an article which is of timely interest, since this is the centenary of John Dalton's famous discovery. Of archæological interest are articles bearing the titles "Discovery of a Roman Palace at Carthage" and "Investigations at Assos." Randolph I. Geare gives a most interesting account of bronze casting in Egypt, Europe, and Japan.

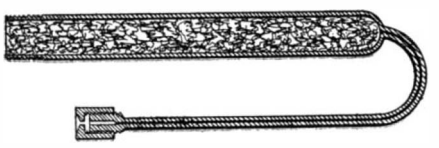
It has been announced that Dr. Charles Wardell Stiles, the well-known zoologist who has been associated with the Marine Hospital Service for several years, has discovered a parasite which is a natural enemy of the mosquito.



LAMP FOR BURNING VAPORIZED GASOLINE.

A patent was recently granted to Mr. E. P. Brown, of Cottonwood Falls, Kan., covering a lamp burning a mixture of air and vaporized gasoline, the oil being vaporized by the heat of the lamp itself. We illustrate herewith one form of this lamp, though obviously the same invention could be applied to many different constructions. The oil is stored in a tank of neat design, placed near the ceiling. Leading down from this is a feeder tube which terminates in a valve just above the top of the lamp chimney. From this point the vaporizer projects at right angles over the chimney and doubles on itself, ending in a nipple at the mouth of the mixing tube. The mixing tube is bent around the lamp and opens into the burner at the bottom. The novel feature of the lamp is the peculiar form of vaporizer, which consists of two sections, as shown in our detail view. One of these sections, which has a circular cross section, contains wire gauze packing, this serving to break up or atomize the oil. The oil then passes into the flattened section, and here it is vaporized by the heat of the lamp or in starting by the heat of the lighted lamp. It is obvious that owing to its shape this flattened section affords an excellent heating surface on which the oil can be quickly and thoroughly vaporized. The vapor thus generated passes out of the vaporizer into the mixing tube, sucking in with it a quantity of air which thoroughly mixes with the vapor while passing on to the burner where the mixture is burned. The lamp can be started with a single match and requires no alcohol torch. We are informed that these burners have been in use for over a year and have proven singularly free from clogging.

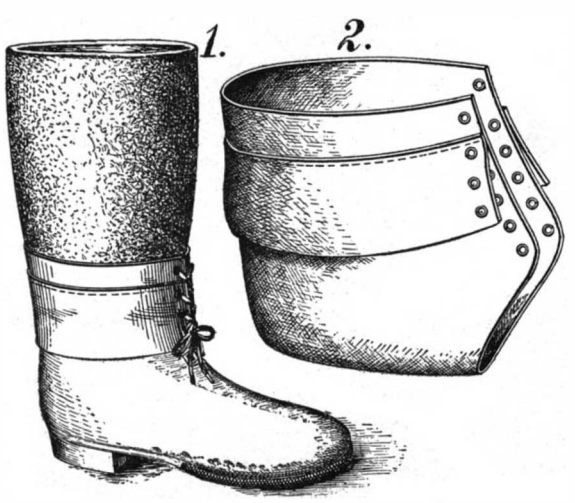
IMPROVED GASOLINE VAPOR LAMP.



THE VAPORIZER SHOWN IN SECTION.

SNOW GUARD FOR LUMBERMEN'S OVERSHOES.

A recent invention which should prove of particular value to lumbermen and others who are obliged to travel through deep snow and slush, provides a foot covering which prevents the intrusion of snow, keeping the feet dry and comfortable. The improvement relates particularly to the boots of felt and the heavy rubber overshoes which are ordinarily worn by lumbermen. It is found that if the vents in the rubber overshoes are closed completely for the exclusion of snow and slush, the ankle joints are so bound that free action of the feet is impeded, and if the shoe vents are not fully closed, so as to incase the ankles, the intrusion of snow and the like will soon wet the feet of the wearer, much to his discomfort. Furthermore, as more or less friction between the heel portions of the



SNOW GUARD FOR LUMBERMEN'S SHOES.

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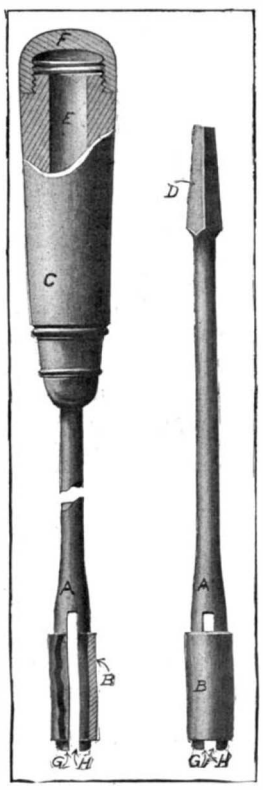
overshoes and like portions of the felt boots is constantly occurring when these foot coverings are worn, the heels of the felt boots quickly wear out and the boots become useless. The present invention, therefore, provides a waterproof leather heel protector shown more clearly in Fig. 2, which is adapted to be slipped over the felt boot, fitting snugly over the heel and extending well up over the ankle. This prevents the wearing of the boot by friction at the heel or at the top of the rubber shoe. A flap or skirt-piece is secured to the upper end of the heel protector, and is adapted to cover the top of the rubber shoe, preventing snow, slush or rain from entering the shoe. Messrs. S. W. Wehn and C. W. Oler, of Everett, Pa., are the inventors of this improved foot covering.

MAGNETIC TOOL HOLDER.

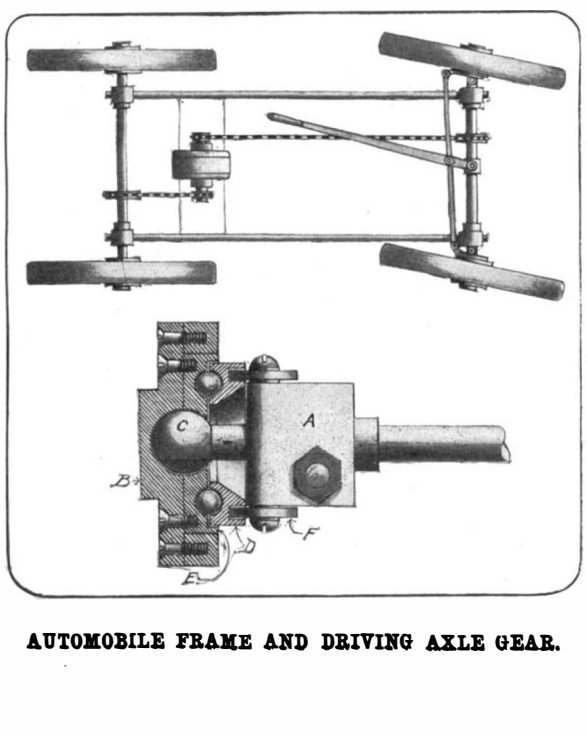
Considerable trouble is often experienced with the screw chucks of an ordinary tool holder, because the tool blade is either too loosely held or else so tightly gripped that it cannot be readily removed. These difficulties are overcome by a new type of tool holder recently invented by Mr. Charles Bellows, of 137 High Street, Boston, Mass. The tool holder as shown in our illustration comprises the shank *A*, with the usual handle, *C*, and the chamber *E*, for the various sizes of tools, also cap *F*, covering the chamber. The lower end of the shank *A* is slotted, forming fingers *G* and *H*. The fingers are of steel and are hardened so as to form a permanent horseshoe magnet. The shank of the tool blade is inserted between the fingers, fitting snugly therein, and is held in position by magnetic attraction. To prevent the fingers from spreading apart when the tool is in use they are encircled by a sleeve of non-magnetic material, such as Benedict metal, which is snapped into the seat formed on the fingers. While the tool is being used, for instance, in driving or removing a screw, the blade will naturally remain in the holder. The magnetism is merely strong enough to retain the blades when they are not in use. Obviously, this form of chuck permits a great saving of time in changing the blades. Where the holder is to be used with a brace or the like, in place of the handle, the shank is provided with a squared end to fit the bit stock.



A MAGNETIC TOOL HOLDER.

AUTOMOBILE FRAME AND DRIVING AXLE GEAR.

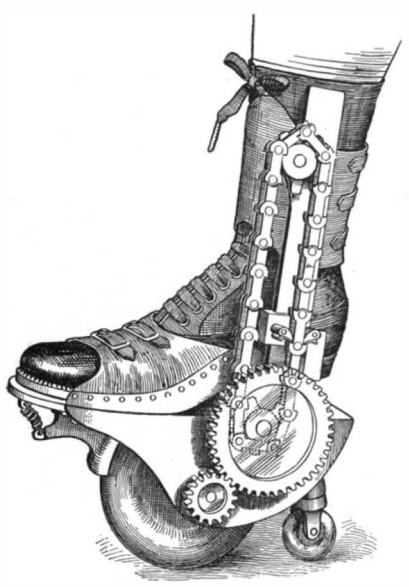
The desirability of connecting the driving power of an automobile with the front instead of the rear wheels, is offset by the difficulty of making connections such that the steering will not be interfered with, and this difficulty has proved an interesting problem for inventors. We show herewith a very good solution of the problem, for which a patent was recently granted to Mr. George R. Boulding, of Wells, Nev. The patent covers also an improved automobile frame which is flexible, enabling the vehicle to ride easily over an uneven road, with all four wheels continuously in contact with the ground. The front and rear axles form part of the frame, being connected with the side frame rods by boxes, *A*, as shown in our detail view. The axles are mounted to turn freely in the boxes, so that the boxes can swing to take up any unevenness in the road. The hubs of the rear wheels may be of any desired pattern, but a special construction has been provided for the front wheels, which permits them to be slewed independently of the frame in steering, and which also permits one wheel to run faster than the other, in rounding corners, thus preventing sliding of the wheels. The front axle is provided with spherical ends, *C*, which enter spherical cavities formed in the hubs. Each hub is made up of two sections, a disk, *B*, and a ring lying along its periphery. Within this ring lies the plate, *E*, which has a ball-bearing on the member, *D*. The member *D* is provided with grooves, near the top and bottom in which the disks, *F*, enter, the latter being mounted on the boxes, *A*. The bottoms of these grooves are convex, so that the disks bearing against them will hold the member, *D*, firmly against the plate, *E*, when the former, which is connected with the steering rod, is swung about in rounding curves. Swinging the member, *D*, therefore, causes the hub to be turned, also, on the spherical portion, *C*, as a pivot. It will be observed that the center opening of the member, *D*, is tapered so as to prevent it from binding on the axle no matter at what angle it is turned. Connection between the hub and the axle is made by means of a pair of spring-pressed pins in the hub, which engage notches in the spherical portion, *C*. In our illustration, the section is so taken that neither of the pins can be seen, but one of the notches is shown. The ends of the pins are beveled so as to engage the notches only when the axle turns forward. In rounding curves, the outer wheel will have to run faster than the inner wheel and the axle by which it is turned. When this occurs, the axle will be moving backward relative to the outer wheel, and this is permitted by reason of the beveled ends of the pins, which slide freely over the notches when they travel in that direction.



AUTOMOBILE FRAME AND DRIVING AXLE GEAR.

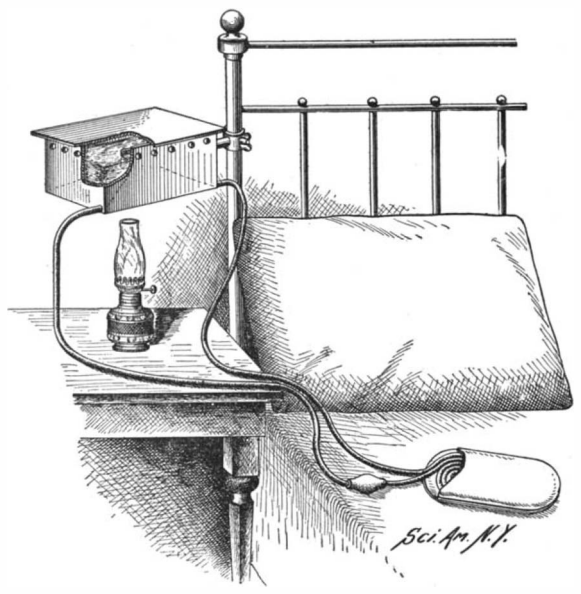
ODDITIES IN INVENTIONS.

FOOT-CYCLE.—A German inventor has designed a foot-cycle of improved construction, in which the springs for raising the foot usually found in such devices are avoided. The support is thus steady and solid, even when the person is at rest. The driving wheel is located under the center of pressure of the wearer's foot, and this enables the person to move in smaller circles than with the usual construction. The details of this cycle may be readily understood from the illustration. Two spring pawls are secured to an extension from the foot-plate, and are adapted when pressed downward to engage projections formed on an endless chain, but to slide by the same when drawn upward. The chain is thus driven forward positively at every downward stroke of the foot, and its motion is communicated through intermediate gearing to the driving wheel. A brake is situated on the forward end of the device, which may be operated by downward pressure at the toe to frictionally engage the driving wheel.



FOOT-CYCLE.

HOT-WATER BAG.—Hot-water bags as commonly made consist merely of a rubber casing in bag form, which is adapted to be filled with hot water. After a time the water loses its heat, and for further use the bag must be emptied of its contents and refilled with hot water. We show here a hot-water bag of improved design in which a constant circulation of hot water is maintained and the inconvenience of refilling the bag is entirely avoided. The device will be found very useful for the sick-room. The bag consists of a casing in which a rubber tubing is snugly coiled. This tubing leads to a reservoir, which may be clamped at a convenient height to one of the bedposts. The water in the reservoir may be properly heated by a lamp placed thereunder. The bottom of the reservoir is bent upward in the shape of a cone, from the apex of which a short tube opens at the top into the interior of the chamber. Heat from the lamp is thus utilized to the best advantage, the products of combustion being drawn up into the reservoir and passing out through perforations in the side walls. The rubber tubing, at a convenient point, is provided with a pressure bulb, at each end of which is a valve. These valves are normally open, so as not to interfere with the proper circulation of the water. By compressing the pressure bulb and subsequently relaxing the pressure, the flow of water may be positively regulated.



HOT-WATER BAG.

MILK-DIPPER.—With the ordinary type of milk-dipper considerable difficulty is often experienced on account of its awkward shape. The usual construction comprises a cup and a long handle, by means of which the milk may be dipped up from the can and poured into the bottles or measures. The cup, as a rule, cannot be filled to the brim, because a large quantity of milk is apt to be spilled in removing and emptying the dipper. We illustrate herewith a milk-dipper which is provided with a tightly-fitting lid. This may be opened by drawing together two levers on the handle. As soon as the dipper has been filled to its full extent, the levers are released and the lid drops down under spring pressure to closed position. The dipper may then be carried to the point desired without danger of spilling the contents. When the dipper is to be emptied the levers are again pressed, opening the cover, and the milk can be poured out as usual. Thus it will be seen that the dipper may also serve as a measure for the quantity taken from the can, since it may always be filled to the limit without danger of spilling.

MILK DIPPER.

Making Fuel from Garbage.

A recent patent granted to Mr. Eugene C. May, of 67 Wabash Avenue, Chicago, Ill., describes a new process of making fuel from garbage. The garbage after being first cleared of metal and glass pieces, or any other undesirable substances, is run through a crusher which breaks up the brittle portions and reduces the softer substances to pulp. About three per cent. of calcium chloride is added to disinfect the mass and it is then dried by evaporation. About 400 pounds of crude oil is now treated with 10 pounds of potassium protoxid, which causes the oil to coagulate and form a soapy substance. The oil is then thoroughly mixed with a ton of the dry garbage, and, with 3 per cent of coal tar as a binding agent, is molded into briquettes ready for use. It gives a clear, dry flame and is entirely free from offensive odors. The fuel was recently subjected to a test by Prof. W. T. McClement, of the Armour Institute of Technology, Chicago, and it yielded the following results:

	Per cent.
Moisture	8.10
Volatile combustible matter	80.387
Fixed carbon	6.06
Non-combustible matter	5.45

The calorimeter gave the following results, the fuel being burned in oxygen:

One pound fuel yielded 21,387.8 British thermal units. This is equivalent to evaporating 22.1 pounds of water per pound of fuel. Ordinary soft coal should evaporate from 11 pounds to 14 pounds of water per pound of coal. Anthracite coal yields sometimes a little more.

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Legal Notes.

Suggested Copyright Improvement.—That copyrights in the United States are in rather a chaotic condition most publishers are more than willing to admit.

Mr. Samuel Elder, of Boston, recently addressed the Maine State Bar Association on what he styles our "Archaic Copyright Laws," and shows in what ways it is possible to better them.

Mr. Elder points out that there is need of revision and simplification of the law of literary and artistic property. As it is the securing of an existing right, and not the creating of a new one, for which the law makes provision, it should liberally protect and not fetter, hamper, or by any possibility defeat the right. "The basis on which our copyright provisions rest is erroneous. It being true that the author's right of property results from his labor, genius, and ingenuity, and that protection was intended to be secured to him because of his dedication of his work to the public, there is no reason why the security itself should be imperiled by a variety of technicalities, or why the value of the work should be frittered away in litigation or questions which have nothing to do with the real work of ownership." Finally, Mr. Elder contends that "the law requires adaptation to modern conditions. It is no longer possible to summarize it in a few sections covering everything copyrightable. It should be revised so that protection to the honest literary worker, artist, or designer shall be simple and certain."

Mr. Elder suggests that a single term of protection would do away with the requirement of a second registration of title and deposit of copies, as well as with the resulting opportunities for complication between the author and his assignee.

A longer term is likewise recommended. Mr. Edward Everett Hale has already outlived the copyright of some of his earlier works. James Russell Lowell's first copyright expired during his lifetime.

The simplification of registration and deposit in the case of newspapers is advocated. Protection "ought to be temporarily extended beyond the mere language in which the news is stated."

Since great expense is incurred by press associations and individual papers in procuring news, "the news itself, the facts stated, should be protected, and not merely the literary vehicle in which it is conveyed, only for a brief period of time."

Mr. Elder believes that some distinction should be drawn between books and plays. Useless formalities should be avoided. The formalities which have come down to us with the first English copyright act of Queen Anne (1709), are the provisions which are "so many traps for the feet of the unwary." Striking examples are given of cases involving the loss of copyright protection because the statutory requirements have not been complied with.

As we have already pointed out in this column of legal notes, the copyright of the "Autocrat of the Breakfast Table" was lost because it could not be proved that copies of the Atlantic Monthly, in which it first appeared, were duly deposited. Detention in an express office for the collection of express charges on Gottsberger's expensive "Ebers Gallery" (its price was $60) led to a loss of copyright. The misprinting of the year date by a single year in the notice of copyright has been held to invalidate the right. The case digested in these columns of the printing of Mrs. Stowe's "The Minister's Wooing," with the notice of copyright in the author's name, before the last chapters of the book appeared in a number of the Atlantic Monthly, bearing notice of the copyright in the name of the publishers, was held, as our readers doubtless remember, to constitute a fatal defect.

The "Professor at the Breakfast Table," having been brought to completion in a number of the Atlantic Monthly which contained notice of copyright in the name of the publishers, was held to be insufficient when subsequent publication was made of the work with a notice of the copyright in the name of the author.

"It is absurd and wicked," says Mr. Elder, "that a slip of a clerk or binder, or a mistake of the author, publisher, or printer, should utterly destroy all copyright protection."

The Loss of Right to Copyright Protection.—The American Press Association secures original and selected matter for publication, which it prepares in the form of electrotype plates, which are leased for publication to subscribers. The matter thus distributed is sometimes copyrighted and sometimes not. The former matter is published with the requisite copyright notice; the latter is credited to the source from which it is obtained.

The Daily Story Publishing Company is engaged in supplying newspapers and periodicals with short copyrighted stories under a form of contract which gives to such newspapers the exclusive right to publish the story furnished, within a limited territory, and upon the express condition that each story when printed shall bear full copyright notice. The St. Louis Globe-Democrat, a patron of the Daily Story Publishing Company, published a copyrighted story, but omitted, through inadvertence, the required copyright notice. Shortly after, the story thus published was appropriated by the American Press Association, and distributed to its patrons by means of its electrotype plates, proper credit being given to the Globe-Democrat. Both firms acted in good faith.

Upon learning that newspapers were publishing the story without copyright notice, the Daily Story Publishing Company presented to the various papers in which the story appeared, bills for damages, threatening suits if they were not paid. The American Press Association promptly informed the Daily Story Publishing Company of the manner in which the story was obtained, assumed responsibility for its use by its patrons, and announced that further publication would be immediately discontinued. The American Press Association filed a bill in the Circuit Court of the United States to restrain the Daily Story Publishing Company from collecting in any manner from its patrons, and damages or compensation, or from instituting any suit therefor, insisting that the Daily Story Publishing Company had lost its right of copyright by publication in the St. Louis Club Democrat. The Circuit Court dismissed the bill and an appeal was taken to the Circuit Court of Appeals (120 Fed. Rep., 766). That the decree was affirmed, goes without saying, for to have enjoined the Daily Story Publishing Company would have been equivalent to depriving it of its right to sue the plaintiffs' subscribers; in other words, depriving it of a right, without due process of law. The Circuit Court of Appeals held that the Daily Story Publishing Company did not lose its copyright rights because the licensee inadvertently neglected to print the required copyright notice.

Construction of Claims in Patents.—In the case of Stillwell-Bierce and Smith-Vaile Company against Eufaula Cotton Oil Company (117 Fed. Rep., 410) the validity and infringement of letters patent granted to John H. Vaile and D. A. Tompkins for a combined cooker and cake former for oil meal were involved.

Judge Day, who wrote the opinion of the case when it came up before the Court of Appeals, held that when the language of a claim for a combination includes an element described only in general terms, the court may look to the specification to ascertain its meaning, and the claim may be limited by the specification, especially where it contains the expression "substantially as described," and the element in the particular form described in the specification is essential to the production of the result which is its most important function. The patentee is not required to describe in full all the beneficial functions of his invention; but if a thing accomplished is a necessary consequence of the improvement made and described, the inventor is entitled to the benefit thereof in construing the patent.

So far as the use of an old element to perform new functions is concerned, Judge Day reiterated the well-known rule that a patent for a combination in which one of the parts performs a new and important function in the operation of the machine, is not anticipated as to such feature by a prior patent for a combination in which a similar part was used in a different place, where it did not perform such function.

The Penn Electrical and Manufacturing Company secured an injunction against the Regent Manufacturing Company and Curry for infringement of a patent taken out by Wright and Curry in 1899 and assigned to the Penn Company. Curry left the Penn Company in 1900. About the same time the Regent Company began to manufacture mirrors. In February, 1901, the Regent Company contracted with Curry thoroughly to organize the mirror factory of the Regent Company, and to suggest such improvements as might appear desirable, and to assist in any capacity necessary to further the interests of said company, at a stated salary. A suit was commenced in April following. The court held that Curry was estopped to deny the validity of the patent; that the Regent Company was in such privity with Curry that it, too, was estopped; that the patent was infringed; and that the Regent Company alone should account, since Curry had no financial interest in the business or in the profits therefrom.

From this decision the defendants appealed (121 Fed. Rep., 80). Judge Baker, who delivered the opinion of the court, held broadly that a patentee, who had assigned his patent, and is in the employ of another, who is making an infringing article, has no ground to object to a decree enjoining him as well as his employer from making and selling such article, where he is not held for the damages caused by the infringement.

The Waterman Pen Cases.—A patent was granted in 1898 to Lewis E. Waterman for an improvement in fountain pens which consists essentially in making a conical taper joint between the cap and the barrel nozzle of the pen. The cap, being thinner and more elastic at the mouth, to form a non-capillary joint, while showing an improved method of construction, did not, in the opinion of the court delivered in the case of Waterman vs. Forsythe (121 Fed. Rep. 103), disclose patentable invention. The court held that the adaptation of joints which were old and well known and in use in other articles made of hard rubber, to use on a fountain pen required only the skill of a mechanic.

It was held in another action against the same defendant (121 Fed. Rep. 107) that patent 293,545, granted to Lewis E. Waterman, 1884, must be conceded patentable novelty and utility, taking into consideration its commercial success; but, in view of the prior art, it was limited to the feature of the claims which describes fissures in the bottom or sides of the ink duct, designed to facilitate the flow of ink to the pen when in use, which were an improvement on any prior construction. As so limited, the patent it was held is not infringed by a pen in which a reed is placed within the duct to perform the function of the fissures in securing capillary attraction.

The Effect of Laches on Damages for Infringement.—In the case of Jennings against the Rogers Silver Plate Company (118 Fed. Rep. 339), it appeared that the complainants had notified the defendants of their claim of infringement before their patent was issued, and promised to give notification of the issuance, but failed to do so. The defendant continued to make and sell the infringing article thereafter, until suit was brought. It was held that the complainants were entitled to recover only such damages as were clearly and strictly proven.

The demand for the article made after the patented device had largely fallen off by the time the patent was issued, in consequence of its having been on the market for a year and a half. It could not, therefore, be held that sales made by an infringer at a price so low as to leave scarcely any profit deprived the patentee of an equal number of sales at the higher prices demanded by him, so as to entitle him to recover the profit he would have made on such sales as damages for the infringement.

Copyrights of Colored Pictures.—The Revised Statutes, Section 4956, authorize the copyright of any "book, chart, . . . cut, print, . . . or design, for a work of the fine arts, provided that in the case of a book, photograph, chromo or lithograph, the two copies of the same, required to be delivered or deposited, shall be printed from type set within the limits of the United States, or from plates made therefrom, or from negatives or drawing on stone made within the limits of the United States."

It was broadly held in the case of Hills & Co. vs. Austrich (120 Fed. Rep. 862) that the books printed in successive colors from metal plates from which part of the metal has been cut so as to leave portions in relief, were entitled to copyright as "prints" within the general enumeration of the section and were not within the proviso, because not "printed from drawings on stone."

While it is unnecessary in a claim of a patent to specify ordinary means for applying power or causing motion, it is necessary to specify the parts whose co-operative action is essential to the performance of the function specified in the claim, and each of such parts is an essential element of the combination, so that infringement cannot be charged of a machine so constructed as to eliminate one of such parts without using an equivalent part.

The mere cessation of infringement is not always sufficient to defeat a complainant's right to an injunction; but where it is shown that defendant abandoned the manufacture of the articles complained of some time before the commencement of suit, without any intention to resume, and there is no reason to doubt his good faith, a preliminary injunction will not be granted.

Where the advance toward perfection in an art consists of many intermediate steps, and several inventors form different combinations or improvements, which score decided advances in the art, and accomplish the desired result with varying degrees of success, each is entitled to his own combination, so long as it differs from those of his competitors and does not include theirs.

King Christian has issued a decree declaring the adherence of Denmark to the Berne International Copyright Convention of 1886, which became operative July 1. The Danish government will allow copyrights on literary and artistic work of the subjects of countries signatory to the Berne convention, and even on works not issued by the Danish publishers.

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

LUBRICATOR.—J. H. WALKER, Lexington, Ky. This invention is an improvement in lubricators especially designed for use on trolleys. In carrying it out the inventor provides lubricating devices in connection with two boxes providing the bearings for the opposite ends of the wheel-shaft and supports these boxes in the harp-prongs, and holds them from turning by proper mechanism.

TURNBUCKLE-STRAIN.—L. STEINBERGER, Brooklyn, N. Y. This inventor has produced a new and improved turnbuckle-strain, the particular object being to provide a device of great tensile strength and which will so distribute the mechanical stress as to subject the weaker parts of the strain to a minimum danger of breaking.

THERMOSTAT.—J. D. GOULD, New York, N. Y. In the practical wiring of a building comparatively short lengths of cable are used, and when the ends are left uncovered or open the soft fusible wire when melted is apt to flow out at the end without closing the circuit. The object of the invention, therefore, is to provide protecting or sealing coverings for the ends of the thermostatic sections which will prevent any outflow, and thus insure the fusion of the conductors between the ends.

Engineering Improvements.

APPARATUS FOR HOISTING AND CONVEYING.—L. S. AUSTIN, New York, N. Y. In this system are employed two endless conveyers, one a bucket conveyer and the other a belt or apron conveyor They travel over pulleys mounted on a shaft and transfer material without drop or shock. Means are provided to close the open sides of a series of buckets, to prevent the premature discharge of the load. A bucket conveyer is used wherein each bucket is fastened at a single point, as by a row of rivets, to the endless apron of such conveyer. Spring connections act to steady and prevent sidewise displacement of the buckets when passing around the pulleys.

MARINE-ENGINE GOVERNOR. — G. F. LASHER, Portland, Ore. The apparatus comprises a float which works in a stand-pipe built in the hull of a vessel immediately contiguous to the stern. This float has connection with a cam which is actuated as the float falls in the stand-pipe, the cam throwing up a rack and causing it to mesh with a continuously-driven worm, whereby the rack is moved longitudinally, and through a connection between the rack and the throttle the speed of the engine is decreased, according to the extent of the movement of the rack.

SELF-CLEARING PROPELLER.—C. H. LEE, Southampton, N. Y. In this case Mr. Lee secures an improvement on his former self-clearing propeller. By mounting or carrying an antifouling device on a part of the propeller itself, he maintains the clearing device and the propeller in a predetermined invariable operative relation. The device is held from rotation with the propeller by retaining devices, the latter being supported by the stern-post or other part of the vessel. The clearing device is loosely fitted to the stationary retaining devices in order that the clearing device may have a certain amount of play with the propeller or its shaft with relation to the retaining device.

ROTARY ENGINE.—A. I. OSTRANDER, New York, N. Y. The invention in this case has reference to improvements in rotary engines, the object being to provide an engine of this character of novel construction adapted to utilize all the energy of the steam, thus resulting in economy of the motive agent.

CABLE-LUBRICATOR. — M. J. MCGILL, Park City, Utah. The particular idea in this improvement is to produce a portable apparatus suitable for lubricating moving cables. The device may be placed in position in a few minutes. It consists of very few parts, and its adjustments enable it to be so used that the lubricant is applied economically and effectually. The parts are all of simple construction and are readily replaced when worn out or broken.

Household Utilities.

TRAY-CARRIER.—CLARA L. POILLON, New York, N. Y. This invention relates to a center handle attachment for trays, whereby the tray may be centrally supported and carried by one hand and so balanced that the liability of dishes or material shifting will be reduced to a minimum. The handle supports a ring, or socket, above the tray, in which ring, or socket, a tea or coffee-pot may be placed to keep warm. An alcohol-stove is placed upon the tray beneath the band, or socket.

SIFTER.—C. B. COMEGYS, Ashgrove, Mo. The improvement relates to that class of household cereal sifters in which a can is provided with a sieve in the bottom and an agitator working over the sieve. This class of devices has heretofore been commercially impracticable on account of cost. This invention seeks to produce a thoroughly durable and efficient sifter at such cost as will insure its extensive adaptation, and this end is attained by certain novel features of construction.

Of Interest to Farmers.

COTTON-PICKER.—H. WISWALL, JR., Washington, N. C. The invention is in the nature of a picker of that type in which a flexible pipe with a suction-nozzle on the end is directed by hand to the open cotton-bolls on the plant, which nozzle is provided with picking devices which loosen and detach the cotton, while the suction from a fan carries the fiber up to a receptacle.

BEEHIVE-FRAME.—H. VOGELER, Newcastle, Cal. This apparatus is strong, simple in construction, and efficient in operation. It overcomes objections of former frames in relation to guarding against crevices, by causing the vertex of a V-shaped edge to pass diagonally across the edge, thereby permitting a greater area for shifting without dangerous disarrangement.

FURNACE.—G. T. WYATT, Olmstead, Ky. The object of this improvement is to provide a furnace for use on the plot of ground used as a hotbed or plant-bed in tobacco-growing districts to thoroughly heat the ground and destroy weeds, seeds, and the like preparatory to sowing tobacco-seed, the furnace being simple and durable in construction, easily moved about, very economical in the use of fuel, and arranged to burn trash and other cheap fuel.

INSECT-CATCHER.—G. I. SILVERA, Crescent, Ora Cabessa, Jamaica. This device is more especially designed for the removal and capture of lice, ticks, and other pests from the skin of cattle, horses, and other animals. It is simple, easily manipulated, and arranged to readily dislodge insects from the skin and gather them in a receptacle for destruction in large quantities.

GRAZING-MUZZLE.—H. G. BANKS, Baum, Indian Ter. The object in view in this new and improved device is to provide a muzzle of simple, light, yet strong construction that will permit an animal to pluck grass from the ground, but will prevent him from eating fruit from trees or bushes, corn from the standing stalk or on the ground, and also prevent the animal from biting trees.

COTTON-PICKER.—J. GRIFFIN, Greenville, Miss. The machine invented by Mr. Griffin is a pneumatic cotton-picker provided with a motor and traction mechanism for driving it through the fields and having an air-blast apparatus operated electrically under the control of an operator or operators. The picker is adapted to easily pass over the cotton stalks.

STALK-CUTTER AND CRUSHER.—R. B. ELISON, Morven, Ga. The inventor of this improvement in stalk-cutters and clod-crushers intends to provide a simple, novel construction whereby to cut up cotton and other stalks and for crushing or chopping up new ground after it has been plowed up or broken up. When desired the machine may be supplied with a tongue, instead of with shafts.

SHOE FOR CLOVEN-FOOTED ANIMALS.—B. BRAND, Braila, Roumania. The characteristic of the invention is that wearing-surfaces corresponding to the shape of the hoof are provided with a light encircling portion and have a horizontally-bent edge which can be forced into a corresponding groove upon the hoof. The whole is secured to the hoof by means of a screw passing through the hoof.

FENCE-POST.—P. CHAPMAN, Council Grove, Kan. It is the object of Mr. Chapman's invention to provide means for supporting fence-posts and securing them to the supports thereof. In one side of a stone base support a groove leads from the top a short distance. Into this the fence-post is inserted and fastened by a horizontal anchor-bolt having a drop-pin connected with its inner end, and a nut applied to its outer end. The post is provided with holders for the line fence-wires.

BAG-HOLDER.—D. W. MITCHELL, Niagara Falls South, Canada. The aim of this inventor is to provide a simple construction of holder by which a bag may be held while being filled, can be filled to the top while being freed from the holder, and in the use of which the bag can be readily applied to and removed from the holder and will be securely held when in connection therewith.

COTTON-CHOPPER.—H. F. MACKEY, Crystal Springs, Miss. The purpose of this invention is to provide a cotton-chopper having independent blades normally engaging in a manner to form a V scraper, the point of the V facing forward, which blades in their combined or V arrangement practically scrape the surplus plants from the rows instead of removing them by a rotary digging or hoe action.

SEEDER.—E. F. MOLCK, Sibley, Ill. In this patent the purpose of the improvement is to provide an end-gate seeder which will be of simple and economic construction, being driven from a wheel of the wagon to which the seeder is applied, and to so construct the seeder that dual hoppers are employed, the main hopper carrying such seeds as oats, wheat, barley, rye, etc., while the auxiliary hopper is adapted to contain clover or grass seed.

Machines and Mechanical Devices.

LIFTING OR SCREW JACK.—J. M. MARZOLF, Homestead, Pa. This contrivance is simple in construction and organization, effective in operation, and comprises few elements, which are not easily broken and which may be readily taken apart and again assembled for use. It is capable of ready application to the lifting of weights or to other purposes.

CUTTER-HEAD.—J. M. KUEBLER, Wausau, Wis. The principal object in this case is to provide a cutter-head in which it will not be necessary to make a new set of knives for each design to be cut out from the work. By means of the construction provided the same knife may be used for different designs, and thus a great saving in tools is obtained.

VARIABLE-SPEED AND REVERSING MECHANISM.—R. B. HAIN, Los Angeles, Cal. Mr. Hain has invented this improved mechanism for producing variable speed or reversing and it is applicable to machinery of various kinds, particularly automobiles or other motor-driven vehicles. It is adapted for driving forward at different speeds or for reversing and driving backward at different speeds.

FOLDING ATTACHMENT FOR CALENDERING-MACHINES.—M. NEWGARDEN, New York, N. Y. The invention relates to that order of apparatus employed in cloth-finishing; and the object is to provide a new and improved attachment for use on the feed-table of calendering-machines designed for making bias and other folds in a very simple, quick, and accurate manner on narrow or wide fabrics.

STOP-MOTION.—G. A. MARTIN, Myerstown, Pa. The intention in this improvement is to provide a new stop-motion, more especially designed for use on knitting-machines, which is simple and durable in construction and arranged to insure a quick stopping of the machine as soon as a yarn or thread breaks or gets caught in the knot-catchers or becomes fastened on the spool or runs slack from the spool.

Railway Accessories.

RAILWAY-BRAKE.—S. CHENEY, Main Street, Freeling, South Australia, Australia. In this patent the improvements relate to brakes which are mechanically and automatically operated by the momentum of vehicles coming together as a result of the speed of an engine being checked. The improvements consist in placing at each end of a vehicle, preferably in the center, a supplementary buffer carried by a lever pivoted to the vehicle-frame and having means upon the vehicles coming together to apply the brakes. Means are also provided to render the buffer inoperative when shunting is carried on.

REFRIGERATOR-CAR. — H. F. STANLEY, New Orleans, La. The present invention relates to freight-cars of the general construction shown in a former patent granted to Mr. Stanley, and it provides a novel means for forming ice-chambers, the partitions and racks that enter into the construction of this feature of the car being arranged to be readily folded into small compass and moved into a position enabling practically the whole content of the car to be utilized for freight when refrigeration is not required.

Miscellaneous.

BUCKLE FOR SEALING MAIL-BAGS, ETC.—J. ANSCHAU, Glen Innes, New South Wales, Australia. This buckle can be effectively sealed without the use of wax; and the essential feature of the invention is a slip of paper, cardboard, or other suitable material carrying a light metal strip adapted to catch on the frame of the buckle. A seal is arranged to overlie the tongue of the buckle in such a way that the strap engaged with the buckle cannot be removed therefrom without destroying the seal.

BOTTLE OR VESSEL STOPPER DEVICE.—G. P. SULLIVAN and Z. P. FREEMAN, Tampa, Fla. The stopper in this invention cannot be withdrawn without leaving indications thereof. It is made nearly of the same diameter as the upper portion of the neck in the bottle, and the head being extended laterally over the edge of the neck it is impossible to insert a wire or other instrument so as to spread the wires and thus effect withdrawal of the stopper without breaking of the wires.

SHOE-HEELING JACK.—J. H. MULLEN, JR., New York, N. Y. In ordinary devices for the purpose of fixing heels on shoes the last is held in place by means of a pin passing in a hole in the last directly in line with the heel, and therefore the last is weakened at this point and soon becomes broken. This invention provides a jack and a connection with the last whereby there will be practically no danger of splitting the last while fastening a heel.

INSERTIBLE CLOSURE FOR LIQUID-RECEPTACLES.—G. H. KLEMM, Fowler, Col. The object claimed in this invention is to provide novel details of construction for the closure of a liquid-package, such as a filled bottle or other receptacle having a neck, which will effectively prevent the refilling of the bottle after its contents have been removed.

SPECTACLE-HOLDER.—R. MCL. GROOMS, Marfa, Texas. The purpose of the inventor is to provide a construction of spectacle-holder adapted to receive the nose-piece and lenses and their frames, holding these parts in a flat protected position and, further, to provide means for holding the curved temples folded one upon the other, and means for securing the free ends of curved temples whenever desired.

NON-REFILLABLE BOTTLE.—L. F. BIZOUARNE, 34 Rue des Apennins, and E. KUGLER, 28 Rue Fessert, Paris, France. The present invention relates to improvements in non-refillable bottles, in which the inventors seek to prevent the fraudulent refilling of a bottle or other container with inferior liquor or other substance and at the same time to permit the contents of the container to be readily drawn off, as may be desired.

REINFORCED NECKTIE-SHIELD.—GERTRUDE FLASKAMP, Hoboken, N. J. The object in view in this invention is to provide a new and improved shield arranged to readily connect the clasp with the reinforcing-strip and secure the latter to the shield to strongly reinforce the latter and to securely hold all the parts in proper position.

CORSET.—J. SCHUFFLAY, New York, N. Y. Means are provided in this improvement whereby to exert a uniform downward and rearward pressure upon the abdomen, reducing this part of the body and producing a long-waisted effect, yet enabling the corset to be worn without discomfort, as the pressure is distributed in two directions from the back waist-line to a point at the central lower portion of the abdomen-section of the corset.

COMBINED PAPER-CUTTER ATTACHMENT AND BOOK-MARK.—C. J. I. DEVLIN, San Francisco, Cal. In this case the aim is to provide a cutter so designed as to form a part of the general make-up of books, magazines, and other publications issued and sold with uncut edges, thereby supplying a reader with means for conveniently cutting the leaves, and to so construct the cutter that it is available as a book-marker.

COMPOSITE MATERIAL.—A. LEISEL, Peekskill, N. Y. Mr. Leisel's invention relates to improvements in composite materials particularly adapted for decorative purposes, such as wall-hangings, signs, panels, etc.; and the object is to provide a composite material that shall be very strong, yet thin and flexible, and capable of ornamentation by embossing, painting, or tinting and be impervious to water.

SINGLE-TRIGGER FIREARM.—J. A. R. ELLIOTT, Kansas City, Mo. In the present case the invention refers to improvements in firearms, particularly double-barrel guns, in which the two hammers are released by a single trigger; and the purpose is to provide simple means whereby the firing mechanism may be set for discharging either barrel first and without danger of firing the other until the mechanism is set therefor.

FOLDING PAPER BOX.—G. A. HARTRAMPF, Atlanta, Ga. The purpose in this improvement is to so construct a box that it will be economic and well adapted for the purpose intended, being capable of shipment in flat form and compact masses and of being quickly and conveniently set up, the bottom being stiffened and blocked to the body when the box is set up either by the weight of the material in the box or by reason of a locking device, or both.

NUT-LOCK.—G. J. CALLAHAN, Rifle, Col. This nut-lock is simple and durable in construction, cheap to manufacture, easily applied, and arranged to permit of proper screwing up of the nut before securely locking the nut in place. Neither bolt nor nut requires special treatment, as the improved washer can be applied to any ordinary bolt and nut now generally in use.

DESIGN FOR TEXTILE FABRIC.—W. S. FRIEDLANDER, Passaic, N. J. This inventor has produced a new, original, and ornamental design for textile fabric. The design comprises a fabric having thereon the representation of pine branches and cones on the branches.

HAIR-CLAMP.—W. J. KOENIG, New York, N. Y. The purpose of this invention is to provide means for holding the end of a braid of hair to prevent the braid from becoming unlaid or to hold a loose bunch of hair in form. To this end the device comprises a novel form of clamp in which the hair is held tightly without entangling the hair in the clamp.

TOY.—I. D. WORCESTER, Pittsburg, Pa. The present invention relates to improvements in that class of toys called "tick-tacks," the object being to furnish an article of this character that may be readily attached to a smooth surface, such as glass, and operating to cause a ticking noise to attract attention to goods displayed, or to afford amusement.

CAMERA ATTACHMENT.—W. R. SMITH, Napa, Cal. The inventor claims as an object the provision of a hood to take the place of the usual focusing-cloth. To this end the improvement comprises certain novel features of construction which enable the attachment to be permanently connected with the camera, yet thrown into open position to reach the interior of the camera for adjustment or other purposes.

LIQUID-MEASURING DEVICE.—C. SIMON, Avilla, Ind. The principal object of the present invention is to provide a simple and inexpensive device which may be connected with a valve of a discharge-faucet of a liquid-receiving tank or receptacle in such manner that the amount of liquid discharged from the tank will be measured and automatically controlled.

MUSICAL INSTRUMENT.—J. A. BARTHOLOMEW, New York, N. Y. The invention consists of novel features and combinations, and the object in view is the provision of a new and improved musical instrument of the whistling type arranged to permit the user to produce an exceedingly loud, far-reaching and harmonious sound.

PENCIL HOLDER AND GUARD.—S. J. DOHRMANN, Louisville, Ky. This device is in that class which comprises a tubular body having an eraser at one end and fitted at its other

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end to receive a pencil; and the invention consists in the special construction of the tubular body in connection with the rubber eraser and the form at the end of the tube which receives the pencil.

WELT-KNIFE.—H. KARPENSTEIN, New York, N. Y. The intention in the present case is to provide an improved knife which embodies means for regulating the depth that the blade may cut into the leather, thus placing the knife more thoroughly under the control of the operator and preventing the implement from injuring the leather or the article by the accidental slipping of the knife.

FISHING AND TRAPPING DEVICE.—R. F. ARMSTRONG, Effingham, Kan. This is a device for catching fish and small animals, but it is particularly adapted for use as a fishing appliance. It relates to that general class in which a tripping or bait hoot is provided in conjunction with a number of impaling hooks, which are spring-actuated and released by the trip-hook to impale the fish when the bait is taken.

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Matthews Torpedo Launches. Matthews & Co., Biscom, Ohio, U. S. A. Builders of high grade power boats.

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(9091) E. L. H. says: Do the heat units in gasoline oil differ in different oils at the same specific gravity? That is, has Penn. gasoline and Coli. gasoline the same heat units in gasoline oil of the same specific gravity? A. The heat value per pound of all gasoline is the same, and for practical purposes the heat value of all petroleum products per pound is very nearly a constant quantity, being not far from 19,600 British thermal units per pound. The heating value per gallon will vary with the specific gravity, depending on the number of pounds of oil to the gallon. 2. In breaking the circuit at platinum points, what causes the spark? Is it caused by the burning of an atom of the platinum or is it electricity? A. In breaking the circuit at platinum points, the spark is caused by heating the particles of air between the points to a white heat, caused by the resistance of the air to the passage of the electricity. The air is heated by the electricity in very much the same way that the carbon filament in the incandescent lamp is heated.

(9092) A. V. B. says: 1. Theoretically what are the most favorable conditions for obtaining the greatest efficiency compound steam engines? A. Theoretically, the highest efficiency with a compound steam engine can be obtained with the highest possible boiler pressure and the most perfect vacuum attainable, and the cut-off in both cylinders arranged so that the steam in each case expands down to the back pressure line. Practical considerations, however, and the influence of the condensation of the steam in the cylinders, materially alter the last half of this statement in practice, and the steam is seldom expanded more than from two to three or three and a half times its original volume in each cylinder of the compound engine. 2. For given stroke, what should be proportionate diameter of cylinders. A. There is no fixed rule governing the proportioning of the diameters of the cylinders of either simple or compound engines. Practice and the judgment of engineers differ widely on this point. You can get a good idea of the proportions that are used in common practice by going over the files of any of the leading power journals and noting the comparative sizes of the cylinders given for the different engines that are described. By making a calculation of such figures from them, you obtain the best rule for cylinder proportions which it is possible to formulate with the present state of our knowledge. 3. Is there any rule for proportioning stroke and diameters of cylinders for given rate of piston speed. A. The piston speed does not materially influence the cylinder proportions, other things being equal, and high piston speed is favorable to good economy, and the best engines have a piston speed varying according to their size and design from 600 feet per minute to 700 or 750 per minute. 4. Which do you consider the best type of compound engine now operating on the different railways? A. The experience with compound locomotives has been too short for engineers to decide definitely which is the best type. With stationary engines, the cross compound Corliss engine is conceded to be the most economical. 5. What are the difficulties to be overcome in adapting the compound engine to the locomotive? These answers to be based on the performance of a two-cylinder compound or one high and one low pressure cylinder. Any information along these lines not covered by questions asked will be appreciated. Please give comparative performance of simple and compound engines, same power working under same conditions, relative to cost of performance, consumption of fuel, etc. A. The difficulties that have to be overcome with the compound locomotive are: First, the difficulty in starting on grade or under heavy load. Second, equalizing the work on the two sides of the engine under all conditions of load. Third, the balancing of the reciprocating parts. Fourth, the difficulty of simultaneously varying the cut-off in the two cylinders in such a way as to get the same effect as is obtained by shortening the cut-off in the simple cylinder. Fifth, the increased danger of breakdowns, due to the more complicated mechanism and the difficulty of getting engineers who can intelligently operate and care for the compound engine. With stationary engines a gain of nearly 40 to 50 per cent may be obtained by compounding. With locomotives the decreased fuel consumption is not quite so great, 35 per cent being perhaps an average figure. If you will write to the Baldwin Locomotive Works at Philadelphia, Pa., for catalogues of their compound locomotives and information regarding their performance, we think they will give you some valuable information.

(9093) W. F. N. writes: I wish to elevate 125 miner's inches of water 18 feet, and have a waste flume 30 feet long, 6 feet wide, 12 inches of water deep, running 20 feet in 4 seconds. What is the best way to do this? There is no fall at end of flume, and I wish to utilize the power the water gives. Would it be best to put in an undershot wheel with lifting buckets in each side, or an undershot wheel and work a centrifugal pump or any other kind of pump that is best adapted to the work? A. The flow of waste water in your flume, at the rate of 20 feet in four seconds, corresponds to only about 3-100 of one horse power. This would lift only about 8-10 of one cubic foot of water to a height of 18 feet per minute, if it could all be utilized. The amount of power available is so small that we do not consider it at all practicable to attempt to use it. A gas engine and a centrifugal pump would probably be your most feasible plan.

(9094) J. N. P. says: Please answer the following questions: 1. How is the horse power of a river estimated, when the depth, breadth, and fall per mile are known? A. The horse power of a river is estimated by first finding the number of cubic feet of water that flow per minute when the river is at its lowest. This may be obtained by multiplying by the average velocity of the water per minute. This velocity may be determined approximately by timing rods loaded at one end as they float down stream. It is next necessary to ascertain what head or fall is available for a waterwheel, in case the river is dammed or canals built. The horse power equals the number of cubic feet per minute multiplied by 62.4, multiplied by the available fall in feet and this product divided by 33,000. 2. How is the horse power of a pipe estimated when the size of the pipe and the quantity of water delivered per minute are known? A. The horse power of the pipe is estimated by multiplying the number of cubic feet of water per minute in the pipe by 62.4, multiplying this by the head in feet, and dividing this product by 33,000.

(9095) A. P. says: Will you kindly inform me which is the best way to can sweet corn for further use so it will not spoil, such as the canning factories do? A. Among fruits, etc., green corn is one of the most difficult to preserve by canning. The following is the method in use by many of the large canning establishments: The corn, after removing from the cob, is filled into the clean cans so as to leave no air spaces. These are placed in a large oven or other air-tight vessel, and subjected to hot steam under pressure. The harder the corn, the longer the exposure required to cure it; it is said that in some cases as much as eight hours is requisite, but usually much less than this. A large vessel of boiling water, in which the cans are immersed, may be used instead of the steam oven, but is not so effective. On removal from the oven or water bath, as the case may be, each can (they must be filled to the cover with fruit) has the cap with a very small hole tapped in its center immediately soldered on. As soon thereafter as the can stops blowing, as the escape of steam and air through the vent is termed, the hole is quickly soldered. This must be done before the air begins to enter. Other fruit is cured and canned in like manner; tomatoes rarely require longer than fifteen to twenty minutes steam curing. Where the pits are left in fruit, a longer time is requisite to completely destroy all fermentative germs.

(9096) C. W. W. asks: 1. What is the theory of the rotary magnetic field? (I do not find the explanations in Thompson's "Elementary Lessons in Electricity and Magnetism" and "Polyphase Currents" quite clear.) How are the poles shifted so as to cause masses of metal to rotate uniformly in the field? A. The theory of the rotary magnetic field is very mathematical and cannot be worked out in a paper. We must refer you to the books upon mathematical electricity. A rotary field is produced by the phases of the current succeeding each other in turn around the field, thus producing currents in the armature coils, or the coils of the rotary portion of the motor, so that the "rotor," as it is sometimes called, is dragged on after the shifting phases of the current through the stationary portion of the motor. The coils of the rotor are closed and have no connection with the external circuit, thus they do not receive any current from outside. 2. What is an induction motor? What special application has it? A. An induction motor is one whose rotation is produced in the manner described above, by the induction of currents in the body of its rotor, due to the induction of the alternation of the phases of the current through its field or stator. It is used for the same purposes as any other motor. It does not require that the current shall be transformed to a direct current, as an ordinary motor does. A long-distance transmission is by alternating currents, many of them being also polyphase. The induction motor can use these directly, or with only the transformation of the voltage. A direct-current motor requires that a rotary converter shall be used to change the current to a direct current. 3. In wireless telegraphy are the electric waves propagated in *all* directions from the antennæ, or in a given direction only? A. The waves from a wireless telegraph apparatus are transmitted in all directions. 4. Is the incessant sparking sometimes observed between the trolley wire and the wheel especially heavy in rainy weather? A. The sparking from a trolley wire is due to the trolley leaving the wire, producing a gap over which the current arcs. 5. In vacuum tubes why does not the current "jump" across the electrodes by sparking instead of "flowing" (as it were) across? What is the "flow" due to? To the gas molecules? A. In vacuum tubes the particles of gas are driven from the cathode in streams across the tube. The character of the discharge through the tube depends upon the degree of exhaustion of the air. With the highest exhaustion no electricity will pass across the space between the terminals even when they are quite near together. See Thompson's "Elementary Electricity."

(9097) S. H. asks: 1. What is the highest rate per second theoretically that the current flowing through the primary of the large induction coil described in "Experimental Science" could be interrupted and still obtain maximum results from the secondary? A. The question of interrupting the primary current in an induction coil is a practical rather than a theoretical one. Nor are we able to say definitely what the upper limit of interruption may be. With the Wehnelt electrolytic interrupter, as high as from 1,000 to 3,000 times per second have been attained. With mechanical breaks the rate is less. With an alternating current 20,000 alternations per minute are recorded in our data; more may have been used. The effects in this instance are said to have been not as great as with a mechanical break. The rate for any particular case may be determined by comparing the musical note emitted by the interrupter with a tuning fork and determining its pitch. The number of vibrations per second will thus be determined. 2. What is the time required for the magnetism to leave the iron core after the current is broken? A. We have no data for demagnetizing iron. The time should be about the same as the rates of vibration given above, since a coil will not give a maximum spark except with the best demagnetizing effect.

(9098) J. L. asks: 1. I have a 1½ horse power gasoline engine run by dry cell batteries. Would I get more speed if I used wet batteries with a dynamo, and why? A. The kind of battery used with your gasoline will not make any difference to its power. The battery is used to produce a spark to ignite the vapor simply. You can do this by a dynamo after the engine is turning fast enough to bring the dynamo up to full speed. But for a small boat you will not gain anything by the change. 2. Does machinery run better at night than day, and the reason therefor? A. We know of no reason why machinery should run better by night than by day.

(9099) C. R. V. says: If a water pump, plunger type, should be made from a tube having a ½ or 5/8-inch bore, and plunger fitting snugly in same, check valve each side, etc., plunger moving or having a stroke of 4 inches, what would be the limit of revolutions per minute if fastened to a wheel and crank, that it would work satisfactorily? Would it be necessary to decrease the revolutions per minute in ratio to increasing the stroke to gain same results as a smaller or shorter stroke? What is the fixed rule for this? A. The most practical speed for the plunger of all pumps is about 100 linear feet per minute. This speed is irrespective of the size of the plunger and the length of the stroke. If this speed is much exceeded, the valves do not seat properly and the pump does not work smoothly. If the stroke is decreased, the number of revolutions per minute may be increased in the same ratio to keep the piston speed the same.

(9100) H. E. C. writes: I am seeking information concerning wagons. I feel quite sure that some experiments have been made relative to the size of wheels, size of axle skein proper, location of load, etc., but I am unable to find such matter in published form. I need the information in preparation of an article for an agricultural paper upon farm wagons. Can you help me out in any way? A. Theoretically, the larger the wheel and the smaller the axle the less the friction. Practical considerations of strength and convenience therefore govern the determining of the sizes of wheels and axles used. As a rule, larger wheels are used on the rear axles of wagons. Therefore, a load can be drawn more easily if it is placed near or over the rear axles. The wagon also steers more readily if the load on the front axle is small. These are the only points governing the location of the load. In Vol. XIV., page 1014, of the Transactions of the American Society of Mechanical Engineers, you will find an article by Thomas H. Brigg on the haulage of horses, which may interest you.

(9101) W. W. R. writes: We have an artesian well here about 1,000 feet deep that is throwing out salt and white sulphur water at the rate of 400 gallons per second. This is correct. I tested it three different times, and made it that or a little over. I am satisfied it will rise in a 6-inch pipe 30 to 50 feet, and

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probably higher. With say a rise of 30 feet, what horse power will it make with a turbine wheel, and what size wheel will it take to run a flouring mill, or will it do it at all? Our town has a population of 600, and could we light the town with the power from well? Say eight large electric lights and 400 incandescent lights for stores and dwellings. A. Four hundred gallons of water per second at a pressure equal to a head of 30 feet would develop 180 horse power. The number of pounds of water per second, multiplied by the head and divided by 5,500 will give you the theoretical power. If this flow of water could be constantly relied on, from 75 to 80 per cent of the above horse power could be generated by a turbine wheel, which would be sufficient to light your town, with considerable margin to spare. It is very doubtful if your well will continue its present output at the pressure which you mention for a great length of time. We would advise you, therefore, to get an expert's opinion on this point before making any large investment.

(9102) C. H. M. says: What is the formula for finding the horse power required to run an air compressor, given the following: The internal dimensions of the cylinder, the speed, and the maximum internal pressure, or the pressure at which the air is delivered from the compressor. A. The horse power required to run an air compressor, neglecting friction, equals the area of the cylinder in square inches multiplied by the internal pressure per square inch, multiplied by the number of feet which the piston moves per minute, and the whole divided by 33,000. Taking friction into account, the power necessary would be nearly double this amount. 2. In finding the exact horse power required, would the external pressure be considered? A. In determining the exact horse power, the difference in pressure of the two sides of the piston in pounds per square inch is the figure that should be used. 3. Of what advantage is a several-staged compressor over a single-staged one? A. A several-staged compressor has the following advantages: The air is compressed less in each cylinder, and therefore a larger amount of air can be forced out of each cylinder per stroke. The valves work more satisfactorily, and there is less leakage, because the difference in pressure on the two sides is less. Second, a small amount of leakage does less harm. The increase in temperature due to the compression in each cylinder is less, and the air may be cooled between the various stages of the compression. The work is more uniformly distributed throughout the entire stroke, making the compressor run more smoothly. 4. What would be the formula for finding the horse power required for a two, three, or four stage compressor? A. The horse power of the two, three, or four stage compressor is found by first finding the horse power of each cylinder, by the method already explained, and adding these amounts together. 5. Is there a formula for computing the horse power of a steam turbine, given the steam or air pressure and the number of cubic feet of steam or air delivered per minute at a given pressure? At what pressure will a turbine work most economically? Does a turbine generate as much power with a given amount of steam as a reciprocating engine? A. There is no reliable formula for computing the horse power of the steam turbine. In general, steam turbines will develop about the same horse power for a given amount of steam as reciprocating engines. A small power turbine at 120 pounds steam pressure non-condensing, will require 40 or 45 pounds of steam per horse power per minute. On the other hand, a larger turbine, designed so as to get the full benefit of the expansion of the steam, when working with steam at 180 pounds pressure and condensing, may be operated with about 16 or 18 pounds of steam per horse power per hour. The higher the steam pressure, the more economical will be the turbine.

(9103) H. M. K. says: I wish to thank you for the answer you mailed me and would be pleased to receive an answer to another question that it aroused in my mind. You said there was no capillary seepage through gas pipes in ordinary ground, as the internal pressure would prevent this. In drilling a gas well with 50 pounds pressure, 500 feet of water is cased off. Would there be any seepage through the casing? If so, at what depth, and how much? Also, why does a 2,000-foot gas well with 900 pounds pressure in the summer time freeze shut, and accumulate 2 or 3 inches of frost outside when the gas is being used? Why do the drilling tools freeze fast when the gas is struck in large wells? A. With a water pressure corresponding to a head of 500 feet, it would be difficult to make the joints in the casings sufficiently tight to prevent some leakage. There would not be, however, any seepage through the walls of a wrought-iron pipe. It is impossible to estimate the amount of leakage in the joints; if the workmanship were absolutely perfect there would be none. The frost which accumulates on the inside of a gas well with a high pressure is caused by the condensation and freezing of the moisture which the gas carries with it. The freezing is caused by the low temperature of the gas, due to its sudden expansion when it escapes into the atmosphere. If the well were capped, and the pressure at the bottom of the well was maintained at the outlet, this expansion could not occur, and there would be no fall in temperature. The frost on the outside of the pipe is due to the condensation and freezing of the moisture in the atmosphere. The drills freeze in the well when gas is struck, if the gas is at a sufficiently high pressure to expand enough to lower its temperature below the freezing point.

(9104) W. M. says: I wish to experiment with compressed air, and desire a little information on that subject. Air compressed to a density of 50 pounds to the square inch and admitted to a cylinder 3 inches in diameter for a distance of 2 inches, how far will the piston travel before losing all its expansive force? Also, at 100 and 200 pounds to the square inch? A. When air expands, its *absolute pressure* decreases in the same proportion that its volume increases, so long as the temperature remains constant. The absolute pressure is found by adding 15 pounds—the atmospheric pressure—to the pressure which is shown by the gage. Thus, if one cubic foot of air at 50 pounds pressure expands to two cubic feet, the absolute pressure after expansion will be $50 + 15 \div 2 = 32.5$. This equals a pressure of $32.5 - 15 = 17.5$ pounds above the atmosphere. In the same way, if the volume were increased to 3 cubic feet, the final pressure would be $50 + 15 \div 3 = 21.6$. This equals a pressure of 6.6 pounds above the atmosphere. This rule can be applied to any pressure and to any change in volume, so long as the temperature remains constant. The rule does not exactly apply to compressed air in the cylinder, because the temperature of the air decreases when the air expands, and this decrease in temperature decreases the pressure somewhat by the figures given by the above rule. Where the expansion is not carried too far, however, the above rule gives results which are approximately correct. If the fall in temperature is known, the final pressure, as determined by the above rule, may be corrected by multiplying it by the following formula:

$\frac{460 + t1}{460 + t2}$ where $t1$ equals the temperature of the air in degrees Fahrenheit at the end of the expansion, and $t2$ equals the temperature of the air in degrees Fahrenheit at the beginning of the expansion.

(9105) R. H. says: 1. Would you please inform me where I can find in some paper a good article on the three-phase system as used in traction? A. We have not printed anything upon this special subject, though there have been paragraphs here and there in articles upon power plants on the Pacific coast and other places. Some traction plants in Italy and Switzerland in which high potential motors are employed have been described in American journals. For articles upon the three-phase system in electric traction, you should follow the engineering journals, such as the Electrical World. 2. I tried to make a storage battery with lead plates and dilute sulphuric acid. I took 16 parts water to 1 of acid. Is that the right proportion? I mixed some red oxide of lead with some glycerine and put it on the positive plate. As soon as I put the plate in the acid water, the red oxide dropped off. What was the trouble? A. The paste made with glycerine and red lead was worthless for a storage cell, since the glycerine was destroyed by the sulphuric acid almost immediately upon coming into contact with it. It probably turned black very soon, owing to the decomposition of the glycerine. The strength of electrolyte employed varies in different forms of cells, but is generally from 1 in 3 parts to 1 in 4 parts of acid in water. The red lead is mixed with the electrolyte and the paste spread upon the lead plate. The details can be learned from a book on storage batteries. Treadwell's is a good one, price $1.75 by mail. 3. How can I tell when the storage battery is fully charged? A. A storage cell is fully charged when the voltmeter shows 2.5 volts. The only certain way to determine full charge is by the voltmeter. Rapid boiling, or escape of bubbles, is a rough way of telling when the cell is charged. 4. I have three cells in the battery, and when I charge them in series small bubbles come up from the plates, and when I charge them parallel there are no bubbles. I can get, however, the same amount of current in both cases. The dynamo runs easier when I charge them parallel. What is the cause of this? A. The bubbles which come off the plates are oxygen from the plate connected to the positive pole and hydrogen from the negative pole of the charging current. They result from the decomposition of water, and when the charge approaches completion the current decomposes more water than at first. 5. Where is the electric light placed in an electric fountain? A. The electric light in an electric fountain is placed so that the beam of light is sent up into the air, and strikes the ascending stream of water. It thus becomes visible. The part of the beam which does not meet water goes on out into space and is not seen.

(9106) T. H. D. asks: 1. Given a number of 16 c. p. incandescent lights, when first operated they may measure up to 16 c. p., but the light given from them gradually decreases until they give out entirely. What is the cause of the decrease in the amount of light given? A. The cause of the decrease of light from an incandescent lamp as it becomes old is an increase in resistance, which cuts down the current which can flow through the lamp with the voltage of the circuit. This increase is due to a decrease in the size of the filament. By the action of the current the carbon of the filament is driven away to the inner surface of the bulb, and can be seen there as a black deposit. This deposit itself also cuts off light. 2. If these lights are sold at so much per kilowatt, will it cost the consumer more to get the same illumination (if possible) from them after having been used, say, three months, than it did when they were first put to work? If so, why? A. Yes; since the current must be brought up by increasing the voltage of the circuit, the watts consumed are increased. After a time it is not possible to bring such a lamp up to full candle power. 3. If the same amount of current is supplied constantly to the meter, will that instrument register a greater or lesser quantity of electricity consumed as the age of the incandescent lights increases? A. If the same amount of current at the same voltage is supplied to a wattmeter, it will register the same number of kilowatts independent of the condition of the lamps. The resistance of the lamps increases with age, and it becomes very wasteful to use them after a certain time, since the light decreases more rapidly than the resistance increases. A reasonable limit for life of a lamp is 500 hours. 4. Is the resistance the same in a new and an old light? A. This topic is treated very completely in Crocker's "Electric Lighting," which we can supply for $6 by mail.

(9107) W. E. H. asks: Can you tell me if there is any machine invented or patented (or in use) to produce power by any of what are called the mechanical powers, such as the wedge, the screw or lever, as a motor solely without any other agent whatever, such as air, water, electricity, heat in any form or chemicals; simply a mechanical motor to drive or operate machinery? I do not mean the perpetual motion fiend business, but something to push and pull with for something. A. We do not know any motor as a generator of power such as you call for, but a lever or any other of the mechanical powers, by the aid of a weight, acting under gravity, will generate power and comes within the limits of your question. They do not use air, water, heat, electricity, or chemicals, but only gravity. They may drive machinery also, but the weight will have to be wound up again after it has run down to its limit. A clock is a machine so driven, and comes well within your requirements. Nor is it a perpetual motion machine.

(9108) L. J. T. says: 1. Will you kindly answer the following in your Notes and Queries: Supposing a hole to be bored through the center of the earth and to the surface on the opposite side, or in the same direction of the diameter of a circle, now if an iron ball was dropped in the hole, where would it stop? A. The ball would stop finally at the center of the earth, if the air is supposed to remain in the hole through the earth, and the rotation of the earth be disregarded. The resistance of the air will ultimately bring the ball to rest. 2. Now, if a vacuum could be created in that hole and the same ball be dropped from the surface in that vacuum, where would the ball stop, the rotation of the earth not to be considered? A. In a vacuum the ball should oscillate to and fro on either side of the earth's center forever, since there is nothing to stop the motion. 3. In the latter case would the ball act like a pendulum swinging in a vacuum and be eventually stopped by the attraction of the earth? A. The attraction of the earth cannot bring the ball to rest, since it acts only to accelerate the motion of the ball as it falls toward the center of the earth on either side of the center, and equally to retard its motion after the ball has passed the center of the earth. The ball will not be stopped by inertia nor by gravity, and would move forever.

(9109) W. B. K. asks: 1. Does the moon have any known effect upon the weather? We are continually hearing about what the weather will do when the moon changes. A. The opinion that the moon controls the weather is firmly fixed in the minds of sailors and unscientific people generally. The authorities of the Weather Bureau have stated that their records of the weather and its changes show absolutely no connection between the changes of the moon and changes of the weather. 2. Please inform me how I shall hold my watch in order to find the north when the sun is shining? I was told to stand facing the sun, to point the hour-hand at the sun, and one-half way from the hour hand to the XII. on the rim of the watch was south. I could not make this come right, but found that one-half way between the hour-hand and the minute hand would give me south. Which is correct, and what is the explanation that makes the watch designate the north? I understand, of course, that the above is only an approximate method of finding the north? A. Your statement regarding the manner of holding a watch to determine the south point of the horizon is correct. The south point is half way between the position of the sun and the twelve-hour mark when the hour-hand is pointed toward the point of the horizon directly below the sun. The explanation is simple. At noon the hour-hand and XII. are together, and both point to the sun, which is then in the south. At one hour from noon the hour-hand is one-twelfth of a circumference, or 30 degs. from XII., and the sun is 15 degs. from the south point, or half way between the place of the hour-hand and XII. The sun moves 15 degs. an hour; the hour-hand moves 30 degs. an hour, or twice as fast. The same reasoning applies to any other hour of the day.

NEW BOOKS, ETC.

L'AIR LIQUIDE. Sa Production, Ses Propriétés, Ses Applications. Par Georges Claude, avec une préface de M. d'Arsonval, membre de l'Institut. Un vol. grand in 8vo, avec photographies d'appareils et instantanés d'expériences. Vve. Ch. Dunod, éditeur, 49, quai des Grands-Augustins, Paris, 6e. Price, $1.00.

Georges Claude is a popular scientific writer best known in France for his "L'Electricité a la Portée de Tout le Monde." This last work, on liquid air, presents in a popular way the most noteworthy achievements in the liquefaction of the so-called permanent gases, and particularly of the liquefaction of air. The first chapter considers first theoretical matters, and secondly the liquefaction of air. In the second chapter the difficult problem of preserving liquid air is presented. Subsequent chapters treat of the properties and physical effects of liquid air, its physical and chemical applications, and the chemistry of low temperatures.

A MANUAL OF CORPORATE MANAGEMENT. Containing Forms, Directions and Information for the use of Lawyers and Corporation Officials. By Thomas Conyington, of the New York Bar. New York: The Ronald Press. 1903. Pp. 331.

Mr. Conyington's volume, although intended for lawyers and corporation officials, has not for its purpose the discussion of corporation statutes, or the law of corporations. The object of the work, as its title indicates, is to present in logical order, something of the details of corporate procedure and of corporate management. Perhaps the most valuable portions of the book are the collated forms which cover almost the entire range of ordinary corporate procedure and are those approved by the leading corporation attorneys. Mr. Conyington has prepared a work which may be regarded as the fullest of its kind on the particular subject which it discusses.

THE BOOK OF CORN. For Farmers, Dealers, Manufacturers, and Others. A Comprehensive Manual upon the Production, Sale, Use, and Commerce of the World's Greatest Crop. Illustrated. New York and Chicago: Orange Judd Company. 12mo. Pp. ix, 368. Price, $1.50.

Despite the great importance of maize, practically no book has as yet been published in which it is adequately discussed. For that reason "The Book of Corn" may be said to supply the proverbial long-felt want. While authoritative both as a practical manual and scientific treatise, the "Book of Corn" is of value to the business man.

STORAGE BATTERY ENGINEERING. A Practical Treatise for Engineers. By Lamar Lyndon, B.E., M.E. New York: McGraw Publishing Co. 1903. 8vo. Pp. 382. Price, $3.00.

This book is intended to assist the practical engineer in designing, installing and maintaining battery equipments and to guide him in the selection of types of batteries and auxiliary apparatus best suited to the service which they are to perform, and at the same time impress upon the technical public both the advantage and limitations of the storage battery in practice.

COTTON MACHINERY SKETCHES. By William Scott Taggart. London and New York: Macmillan & Co. 1903. 8vo. Pp. 104. Price, 60 cents.

The drawings of which this book is comprised are reproductions of illustrations selected from the author's work on cotton spinning. The book is intended for the use of such teachers who desire to present a sketch to their pupils and to explain the sketch in the particular way they have found to be most desirable for their purpose. Students may use the work for practice in sketching and for the purpose of developing their own descriptive powers in explaining a machine, without being influenced by the description associated with the drawing in a text book.

YEAR BOOK OF THE AMERICAN POWER BOAT ASSOCIATION. New York: The Rudder Publishing Co. 1903. Pp. 46. Price, 25 cents.

The rapid growth of interest in power boats and the remarkable strides made by the industry of late years is one of the signs of the times in the yachting world. A recent development is the attention that is being attracted to power-boat racing which promises to obtain a hold upon the yachting man and the general public second only to that of the sailing yacht. The American Power-Boat Association was formed to promote the use of power boats and the improvement of their design, etc., and formulate rules for racing. This small volume contains full information regarding the organization, jurisdiction, etc., of the Association; the racing rules, 27 in number, and a table of time allowances.

LLOYD'S REGISTER OF AMERICAN YACHTS FOR 1903-4. New York: Lloyd's Register of Shipping. 1903. Pp. 450. 42 pages of flags and signals. Price, $7.50.

The large and rapid increase in recent years in the fleet of American yachts has called for a separate register of them. The book con-

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tains particulars of 850 steam and power yachts, and 1,939 sailing yachts, or a total of 2,789 yachts, all of which are owned in the United States or Canada. The addresses, clubs, and yachts of upward of 2,500 owners are given in a separate list arranged alphabetically according to the names of the owners. There are illustrations in colors of the flags of 94 American and Canadian yacht clubs, with the names of their officers, in the book, and 1,073 private signals of yacht owners. A list of the yacht builders and designers of the United States also appears, with the names of the yachts built or designed by them, and lists of signal letters, and of late names of yachts.

THE NATURE STUDY IDEA. By Prof. L. H. Bailey. New York: Doubleday, Page & Co. 1903. 12mo. Pp. 159. Price, $1.00.

This interesting volume is an illuminating and suggestive study of the new movement, originating in the common schools, to put the child into sympathy with Nature and his environment, to the end that his life may be stronger and more resourceful. The movement relates education directly to the life that the pupil is to live. It is a fundamental, epoch-making movement. It is a revolt from mere science-teaching in the grades and from all perfunctoriness in school work. It is the full expression of personality. It is not the mere addition of certain studies to a curriculum, but the inspiration of a new point of view in education. More than any other recent movement, it will touch the masses with a new educational impulse.

DISCOURSES ON WAR. By William Ellery Channing. Boston: The International Union. 1903. 12mo. Pp. 229.

Those who are opposed to the present militant spirit of the world will find much that will interest them in the volume before us.

VENTILATION IN MINES. By Robert Wabner. London: Scott, Greenwood & Co. New York: D. Van Nostrand Co. 1903. 8vo. Pp. 240. 30 plates. Price, $4.50.

A thoroughly modern work which deals with one of the most difficult problems known to the mining engineer—the supply of a uniform quantity of fresh air so that the workers can perform their task safely, at least, if not in comfort.

MUNICIPAL PUBLIC WORKS: THEIR INCEPTION, CONSTRUCTION AND MANAGEMENT. By S. Whinery. New York: The Macmillan Co. 1903. 12mo. Pp. 241. Price, $1.50.

This book is intended for the inexperienced city official and for the urban citizen. Numbers of good and earnest men are elected or appointed to official positions in our municipal governments whose interests and previous business experience and training have not been of such a character as to lead them to study the principles controlling and the problems that will be met with in conducting municipal public works, and who, upon assuming the duties and responsibilities of office feel that they are deficient in the special knowledge necessary to enable them to discharge intelligently and efficiently the duties of their new positions. To all such persons the book will commend itself.

PHOTOGRAPHIC LENSES. A Simple Treatise. By Conrad Beck and Herbert Andrews. New York: Tennant & Ward. 1903. 12mo. Pp. 288. Price 75 cents.

The book before us is the first work of its kind to be written by a lens manufacturer of repute. The work is not intended to give a very scientific explanation of the laws which underlie the construction of the photographic lens. It explains, for the benefit of the photographer, what he ought to know about his lens; how it should be used; how its efficiency should be judged, and how some of its scientific principles may be understood. The treatise, as the title page indicates, is simple—so simple, indeed, that any photographer should be able to grasp its explanations easily.

POSSIBILITIES OF SMALL LATHES. By James Lukin, B. A. London: Guilbert Pitman. 1903. 16mo. Pp. 130. Price, 60 cents.

The author is a well-known amateur mechanic and his instructions are always thoroughly practical. The book is an excellent one and will appeal to many of our readers. It is unfortunate that the illustrations are so poor.

THE SOLAR SYSTEM. By Percival Lowell. Boston: Houghton, Mifflin & Co. 1903. 12mo. Pp. 134. Price, $1.25.

The author has written an excellent book which will appeal to all astronomers, although it is hardly adapted to the use of those who are not familiar with a certain amount of mathematics.

A TREATISE ON BEVERAGES: or, THE COMPLETE PRACTICAL BOTTLER. By Charles Herman Sulz. New York: Dick & Fitzgerald. 1903. 8vo. Pp. 818. 428 illustrations. Price, $7.50.

The volume before us is one of the most satisfactory technical books which has come to the editor's table in some time. The subject is dealt with in a thoroughly adequate manner, as is shown by the fact that 116 pages are given up to water, its examination and filtration. The instructions for doing all kinds of bottling of aerated and other beverages are very full, and all the best types of apparatus are shown. The section devoted to mineral waters is particularly full and the analyses are most complete. Americans have carried the manufacture of artificial mineral waters and aerated beverages to a higher state of perfection than has hitherto been known, and this fact is easily demonstrated by this very satisfactory book.

THE COPPER HAND BOOK. A Manual of the Copper Industry of the World. Vol. III. of the year 1902. Compiled and published by Horace J. Stevens, Houghton, Mich. 8vo. Pp. 600. Price, $5.

This is the third annual issue of the "Copper Hand Book," and includes the history of copper, the geology of copper, the chemistry and mineralogy of copper, its metallurgy and its uses. It also deals with the copper deposits of the United States and Canada and Newfoundland, as well as foreign countries. The statistics relative to copper are most valuable.

LENKBARE BALLONS: RÜCKBLICKE UND AUSSICHTEN. Von Hauptmann Hoernes. Leipzig: Wilhelm Engelmann. 1902. 8vo. Pp. 359.

Capt. Hoernes has produced one of the most thoroughly scientific and scholarly treatises on aerial navigation which has ever come before our notice. He has exhaustively discussed the history of the airship, carefully reviewing the construction of and the results obtained with the Giffard, Dupuy de Lome, Haenlein, Baumgartner, Woelfert, Tissandier, Renard and Krebs, Schwarz, Zeppelin, Santos-Dumont and Deutsch airships. Through six chapters he discusses elaborately the principles of aerial dynamics and their influence upon the structure of the airship, basing his conclusions upon the results obtained with airships and balloons of widely different design. His concluding chapter is of a more theoretical nature and treats of the possibility of finally solving the problem of aerial navigation and the form which the solution may be expected to assume. Not the least valuable portion of Capt. Hoernes' admirable work is comprised of meteorological tables to which the aeronaut may refer for wind velocities during each month of the year for different years. An excellent bibliography and exhaustive index are provided.

PRACTICAL FARM DRAINAGE: WHY, WHEN AND HOW TO TILE DRAIN. By C. G. Elliott. New York: John Wiley & Sons. 1903. 16mo. Pp. 92. Price, $1.00.

A thoroughly practical book by a drainage engineer. The methods have been well tested and are now in constant use.

GAS ENGINE TROUBLES AND REMEDIES. By Albert Stritwatter. Cincinnati, n. d.: The Gas Engine Publishing Co. 16mo. Pp. 112. Price, $1.00.

The care of gas engines is dealt with only to a limited extent in works on the subject, so that the present eminently practical book will be a welcome addition to the literature of this modern power.

WIRELESS TELEGRAPHY AND TELEPHONY. Compiled by Dr. Maurice Ernst. London, n. d.: Electricity Office. 12mo. Pp. 32. Price, 40 cents.

This undated book on wireless telegraphy is unfortunate, in view of the strides which wireless communication is making. It is largely devoted to the Orling-Armstrong system. It contains a serviceable bibliography.

THE RESTORATION OF THE ANCIENT IRRIGATION WORKS ON THE TIGRIS: OR, THE RE-CREATION OF CHALDEA. By Sir William Willcocks, K.C.M.G., M.I.C.E. 8vo. Pp. 71, ten plates.

BRITISH STANDARD SECTIONS. New York: D. Van Nostrand Co. 1903. 9 charts. Price, $1.00.

These charts of British standard sections are issued by the Engineering Standards Committee, which is supported by the various engineering societies. Each subject, as T-bars or bulb-plates, has a drawing of the section and is accompanied by a table of dimensions and remarks. The tables should find their way to the drawing offices of all constructing engineers.

THE ART OF LIVING LONG. Milwaukee: W. F. Butler. 1903. 8vo. Pp. 214.

This volume is a new and improved English version of the Venetian centenarian Louis Cornaro, who was born in 1464 and died in 1566. Essays by Joseph Addison, Lord Bacon, and Sir William Temple are included. The work has been compared with ancient documents preserved in Italian archives. The book is an Italian classic and is worthily presented, and an example of good humanist literature.

DIE BRIKETT-INDUSTRIE UND DIE BRENNMATERIALIEN. Von Dr. Friedrich Juenemann. Vienna: A. Hartleben. 1903. 12mo. Pp. 320. Price, $1.75.

It must be confessed that the Germans have far outstripped us in the invention and manufacture of artificial fuels. In the briquetting of various substances they have certainly made marked advances. Dr. Juenemann has collected in this book all those methods which have in Germany proved themselves of practical value. He describes not only the processes used, but also presses and other machinery which enter so largely into the equipment of the briquetting plant.

LIMITS TO SEEING AND HEARING; OR, THE GREAT SCALE. Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 16.

THE STOURBRIDGE LION. A compilation of authorities proving the claim made for the Stourbridge Lion as having been the first locomotive to turn a wheel on the Western Hemisphere. Together with a brief biographical sketch of Horatio Allen, the first locomotive engineer in America. By Edward A. Penniman. Honesdale; Pa.: Citizen Print. 1903. Pp. 17.

DIE ENDGÜLTIGE LÖSUNG DES FLUGPROBLEMS DURCH EMIL NÉMETHY, FABRIKS-DIREKTOR IN ARAD. Mit drei in den Text gedruckten Abbildungen und einer Figurentafel. Leipzig: Verlagsbuchhandlung von J. J. Weber. 1903. Pp. 23.

THE JOURNAL OF THE DEPARTMENT OF AGRICULTURE OF VICTORIA. Published For and on Behalf of the Government by Direction of the Hon. J. W. Taverner, M.L.A., Minister for Agriculture. Edited by D. McAlpine. Melbourne. 1902. Pp. 731, 835. Vol. 1, Part 8. August, 1902.

THE JOURNAL OF THE DEPARTMENT OF AGRICULTURE OF VICTORIA. Published For and on Behalf of the Government by Direction of the Hon. J. W. Taverner, M.L.A. Edited by D. McAlpine. Melbourne. 1903. Pp. 837, 921. Vol. 1, Part 9. September, 1902.

JANET CHARLES: OBSERVATIONS SUR LES GUEPES. Paris: C. Naud, Editeur. 1903. Pp. 85.

CALORIMETRY. By Frank H. Bates. Philadelphia: Philadelphia Book Co. 1902. 16mo. Pp. 127.

THE TRAP NEST TEXTBOOK. By F. O. Welcome. 8vo. Pp. 129.

REPORT OF THE LIBRARIAN OF CONGRESS FOR THE FISCAL YEAR ENDING JUNE, 1902. 8vo. Pp. 278.

THIRTY PICTURES OF TUBERCULOSIS. By Addison W. Baird, M.D. New York: James T. Dougherty. 1903. 8vo. Pp. 24. Price 25c.

CRIMINAL RESPONSIBILITY OF THE EPILEPTIC. By John Puton, M.D. New York: William Wood & Co. 1903. 16mo. Pp. 11.

NINETEENTH ANNUAL REPORT OF THE BUREAU OF AMERICAN ETHNOLOGY TO THE SECRETARY OF THE SMITHSONIAN INSTITUTION. By J. W. Powell, Director. In Two Parts. Part II. Pp. 5771, 1160.

UNITED STATES GEOLOGICAL SURVEY: MINERAL RESOURCES OF THE UNITED STATES, CALENDAR YEAR 1900. David T. Day, Chief of the Division of Mining and Mineral Resources of the United States Geological Survey. Washington: Government Printing Office. 1901. Pp. 927.

SUBJECT LIST OF WORKS ON GENERAL SCIENCE, PHYSICS, SOUND, MUSIC, LIGHT, MICROSCOPE, AND PHILOSOPHICAL INSTRUMENTS IN THE LIBRARY OF THE PATENT OFFICE. Published at the Patent Office, 25 Southampton Building, Chancery Lane, London, W. C. Pp. 183. Price 25c.

MODERN MEXICO: STANDARD GUIDE TO THE CITY OF MEXICO AND VICINITY. By Robert S. Barrett. Third Edition. Modern Mexico, 2a Independencia 8, City of Mexico, Mex., and 116 Nassau Street, N. Y. 1902-3.

GEOLOGIC ATLAS OF THE UNITED STATES—MASONTOWN-UNIONTOWN FOLIO: PENNSYLVANIA; INDEX; MAP. Washington, D. C.: Engraved and printed by the United States Geological Survey. 1902.

GEOLOGIC ATLAS OF THE UNITED STATES—CHICAGO FOLIO: RIVERSIDE, CHICAGO, DESPLAINES, AND CALUMET QUADRANGLE; ILLINOIS-INDIANA. Washington, D. C.: Engraved and printed by the United States Geological Survey. 1902.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

July 14, 1903,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Adhesive applying mechanism, J. C. F. Balze 733,361
Advertising device, W. A. Demmon 733,819
Air brake safety angle cock, McGuire & Wahl 733,503
Ammonia from ammonia containing gases, obtaining, H. H. Dow 733,465
Annunciator, F. W. Dunbar 733,468
Annunciator, electrical, J. H. Taylor 733,883
Apparel, article of, J. Steinborg 733,603
Armature coils, form for winding, W. F. Drees 733,633
Automatic lubricator, A. A. Freeman 733,382
Automatic switch, H. H. Doll 733,822
Bag holder, B. H. Willsie 733,449
Bailing press, T. A. Killman 733,849
Barge, freight, L. P. Harvey 733,583
Bath apparatus, shower, L. P. Dunn 733,635
Battery connection, L. Chronik 733,697
Battery element, L. Chronik 733,696
Bed bottom, W. D. Hunt 733,650
Bed bottom, C. Vallone 733,772
Belt, metallic money, W. E. Halladay 733,478
Belting, C. Heron 733,393
Bevel joint, compound, S. W. Moore 733,500
Bicycle, P. W. Tillinghast 733,518
Bicycle carrying attachment, L. Murdoch 733,865
Binder, loose leaf, W. Saunders 733,599
Bird chaser, W. F. Weber 733,778
Bit. See Bridle bit.
Blacking device, shoe, W. G. Callender 733,370
Bobbin, A. A. Sack 733,557
Bolster, C. B. Albree 733,791
Bolt locking device, J. F. Clegg 733,541
Bolting cloth, brush device for cleaning, C. W. Mann 733,858
Book, manifold account and sales, G. A. Holm 733,841
Boot finishing machine wheel, G. H. Catt 733,577
Bottle funnel neck, water, R. D. Bradley 733,899
Bottle tin foiling machine, Twitchell & Brown 733,771
Bottle washing machine bottle holder, B. F. Schirmer 733,558
Brake beam, L. A. Shepard 733,433
Brake beam, P. T. Handiges 733,839
Brake beam, A. Lipschutz 733,854
Brake system, electric, F. E. Case 733,900
Braking moving loads, F. E. Case 733,901
Bread mixer and kneader, J. F. Stevens 733,763
Bridle bit, W. T. Temple 733,769
Bromids from bromin containing solutions, manufacturing, H. H. Dow 733,467
Bromin, manufacturing, H. H. Dow 733,466
Brooder, I. Morrow 733,863
Buggy, baby, S. C. Wolfskill 733,889
Building block and wall, J. A. Ferguson 733,928
Building, metallic, J. Spelman 733,435
Bulkhead or other doors, mechanism for operating, G. C. Ralston 733,745
Bunk or mattress frame, J. P. Lein 733,405
Bunsen burner, A. B. Redell 733,424
Button or fastener, Walter & Kunstner 733,443
Cane, etc., electrical rotary portable machine for cutting sugar, S. J. Hylton-Bravo 733,587
Car brake rods, brake jaw for, A. Lipschutz 733,853
Car coupling, P. Brown 733,620
Car, dump, Wolff & Lipschutz 733,786
Car, push, M. C. Hamilton 733,390
Carbon brush holders, clamp for use in connection with socket, O. M. Stiegler 733,436
Carbureter, L. F. Washburne 733,444
Carbureter, G. H. Maurer 733,498
Carbureter for motor bicycles, A. Clement 733,625
Carbureter for petroleum motors, pulverizing, Charron & Girardot 733,695
Carding machine, M. J. Gahagan 733,383
Carding roll teeth, tool for straightening, N. G. Huffstickler 733,394
Carpet-stretcher, T. J. Hall 733,716
Carpet sweeper, A. H. Dodd 733,904
Carrier. See Fruit carrier.
Carton closing machine flap holder, Redd & Cormack 733,510
Carton ends, blocks for machines for forming, C. Redd 733,509
Carton ends, machine for closing and sealing up, C. Redd 733,506
Carton holder for machines for folding and gluing the end flaps of cartons, G. H. Cormack 733,460
Cartridge primer, J. Gardner 733,638
Casings, machine for the manufacture of, A. Mauser 733,728
Cash register, A. Godefroid 733,476
Cash register, C. F. Crowder 733,815
Ceiling anchor, M. Murray 733,671
Cellulose esters, making, G. W. Miles 733,729
Centrifugal machine driving mechanism, G. Engel 733,377, 733,378
Chafe-iron, roller, A. P. Smith, Jr. 733,513
Chair, H. E. Knauss 733,659
Chair, C. C. Black 733,803
Chair, J. A. Manahan 733,857
Check hook, spring, F. Clark 733,903
Chimney cowl, F. W. Stein 733,762
Chuck, G. C. Gammell 733,546
Chuck, centering, J. Rusche 733,753
Cigar making machine, D. Cousinne 733,576
Cistern forming device, adjustable, N. Brown 733,810
Clarifying apparatus, T. W. Manning 733,726
Cleats to barrels, etc., machine or tool for applying holding, A. T. Pope 733,743
Clutch, friction, E. Liken 733,406
Coal drill support, A. Walker 733,775
Coal or wood bag, F. S. Converse 733,542
Coat lining, M. Weber 7 33780
Cock, gage, W. Guethler 733,548
Coke oven, G. S. Ramsay 733,872
Coke, removing silica from, C. M. Hall 733,389
Collar, horse, W. C. Lawson 733,911
Collar retainer, R. P. Schilling 733,680
Composition of matter, K. N. Lundblad 733,407
Concrete or plastic material, mold for making articles of, J. A. McNamee 733,735
Condenser for nitric or other acids, Bate & Orme 733,452
Conveyer, J. F. Cook 733,373

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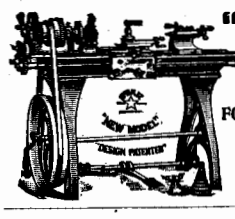
Conveyer, F. E. Blaisdell 733,804
Corn cutting and crushing machine, J. S. Bloom 733,454
Cotter, E. W. Merrill, Jr. 733,669
Cotton press, J. J. Atkinson 733,451
Counter and index, J. M. Cory 733,626
Coupling, P. H. Mack 733,408
Cover, receptacle, E. J. Gorman 733,580
Cream separator and churn, A. D. Frederick 733,545
Cream whipping machine, F. E. A. Brock .. 733,456
Crossing alarm, automatic, J. P. Church 733,698
Cultivator, C. L. Swanson 733,516
Cultivator and grader, roller, Dungan & Stelle 733,634
Cultivator attachment, W. H. McElree 733,734
Cultivator, cotton planter, and fertilizer distributer, combined, L. R. Randall 733,873
Cultivator planting attachment, J. W. Benton 733,801
Curtain drying apparatus, H. S. Hildebrand 733,718
Curtain hanger, L. E. Trax 733,519
Cuspidor, Shade & Knapp 733,431
Cut off for house plumbing, C. G. Woods .. 733,788
Cutter bar sections, machine for testing, Barker & Corl 733,794
Cutting machine, W. Ross 733,427
Cutting tool, C. T. Ridgely 733,511
Damper, pipe, H. J. Noyes 733,737
Damper, stove or furnace pipe, E. N. La Veine 733,404
Damper time controller, E. Zwicker 733,530
Demagnetizer, W. J. Forster 733,637
Dental machine frictional gearing, L. L. Bosworth 733,807
Disinfecting apparatus, M. Otto 733,673
Display stand and truck, combined, J. A. Kelly 733,847
Domestic boiler, H. A. Miller 733,730
Door, automatically opening or closing sliding, B. H. Löffler 733,493
Door controlling means, A. D. Caywood 733,624
Door, inside grain, A. S. Swenson 733,517
Draft rigging, solid, E. Lewis 733,720
Dress suit cases, traveler's reclining attachment for, C. C. Taylor 733,767
Drill. See Grain or fertilizer drill.
Drill attachment for drill presses, multiple, Kehl & Goers 733,719
Drill cleaning device, disk, O. A. Poirier ... 733,593
Eccentric, C. W. Lee 733,852
Egg beater, W. G. Browne 733,621
Electric accumulator, active material, S. A. Rosenthal 733,918
Electric conductor conduit and trough, T. E. Devonshire 733,631
Electric controller, D. L. Lindquist 733,551
Electric controller, A. Sundh .....733,563 to 733,567
Electric incandescent light wires, fire arrester for, O. H. R. Schulze 733,876
Electric meter bearing, G. H. Alton 733,611
Electric motors, electrohydraulic controller for, A. Sundh 733,562
Electric socket, W. S. Stapley 733,759
Electric switches, cut-outs, etc., means for protecting the exposed or live parts of, W. McDevitt 733,502
Electric time switch, I. S. & E. F. Callender 733,369
Electric vapor appliance, M. von Recklinghausen 733,423
Electrolytic apparatus, L. Gurwitsch 733,643
Electromagnet, D. L. Lindquist 733,549
Elevator, J. S. Muckle 733,864
Elevator car signaling apparatus, C. A. Reimers 733,750
Elevator doors, locking attachment for sidewalk, P. H. Jackson 733,652
Elevator gate operating mechanism, C. L. Colby 733,459
Elevator safety appliance, electric, G. L. & G. Hail 733,715
Elevator safety clutch, J. A. Bridges 733,455
Elevators, electric controller for hydraulic, J. W. Moore 733,553
Embossing molds, preparing, E. O. Loveland 733,856
Enameling, work-holder for, S. H. Frist 733,831
Engine current breaker, hydrocarbon, G. R. Albaugh 733,894
Engine speed regulator, explosive, H. A. Gilman 733,384
Engines, air and gas mixer for explosive, T. Charlton 733,902
Equalizer, four-horse, J. W. Gamble 733,832
Excavator, P. J. Raymond 733,422
Exhibiting apparatus, E. Barthelemy 733,796
Eye-shade, T. Little 733,721
Eyeglass frame, bar spring, H. Tremblay .. 733,529
Eyeglasses, F. X. Gartland 733,639
Faucet attachment, C. A. Smith 733,881
Feed water heater, B. J. White 733,783
Fence, E. L. Froggatt 733,906
Fence, wire, B. B. Wood 733,890
Fertilizer distributer and seed drill, W. L. Kennedy 733,848
Fiber preparing machine, M. Prieto 733,595
File, document, W. O. Gottwals 733,547
Filling can, J. W. Jack 733,486
Filter, R. S. Brownlow 733,622
Filter, water, W. G. Tousey 733,885
Filtering press, V. Lapp 733,663
Fire extinguishers, sprinkler head for automatic, G. E. Hibbard 733,646
Fire extinguishing apparatus, J. W. Rapp .. 733,421
Fire shield, J. J. Plucker 733,916
Firearm, automatic, J. T. S. Schouboue 733,681
Fishing rod, Hall & Smith 733,836
Flash boiler, A. A. Ball, Jr. 733,613
Flash lamp, A. Duthie 733,705
Flue cutter, J. C. Groble 733,642
Flue hole cutter, J. G. Dixon 733,821
Folding table, J. A. Knight 733,661
Fruit carrier, G. W. Stevens 733,683
Fruit picker, J. S. Hamilton 733,479
Furnace petroleum burner, E. D. Dennison. 733,463
Gambrel, L. Neathamer 733,672
Game apparatus, M. S. Bliss 733,365
Game apparatus, J. N. Arriaga 733,793
Game apparatus, Koch & Fischer 733,850
Game board, H. L. Haskell 733,644
Gang plank, J. Riley 733,598
Garment, W. E. Warner 733,776
Garment triple supporter and adjuster, H. E. Grebner 733,388
Gas and backwater trap and tide and flushing gate, sewer, F. W. Rathbun 733,748
Gas burner, incandescent, A. Farkas 733,473
Gas check, G. A. Brachhausen 733,618
Gas generator, acetylene, J. S. Philpott 733,740
Gas lighting attachment, automatic, C. F. Mason 733,667
Gases, means for controlling the flow of, H. H. Dow 733,464
Gaseous fuel burner, O. Falkenwalder 733,828
Gate. See Railway crossing gate.
Gate, H. Terry 733,684
Gate for coal or other pockets, J. Campbell 733,623
Glassware, machine for the manufacture of, C. E. Blue 733,805
Glassware, machine for the manufacture of, Blue & Jones 733,806
Gluing wheel, C. Redd 733,508
Governor for gasoline engines, sparking device, O. J. Root 733,752
Governing mechanism, valve, W. W. Spinney 733,757
Grain dump and elevator, portable, E. & H. V. Schroeder 733,430
Grain elevator, C. F. Dueringer 733,824
Grain or fertilizer drill or distributor, B. F. Robinson 733,512
Greenhouse, F. S. Ford 733,829
Grinding and pulverizing mill, T. Breakell. 733,574
Grinding file blanks, etc., machine for, J. Turner 733,439
Grinding mill, H. Scharbau 733,875
Gun fluid pressure brake, O. Behnke 733,798
Hand strap, J. H. Myers 733,866, 733,867
Harness, S. Way 733,887
Harvester attachment for raising and saving down grain, W. M. Wadleigh 733,442
Harvester, potato, O. Kirkham 733,589
Harvesting machine shocking device, W. Doering 733,375
Hat forming machine, G. W. Chamberlain 733,812
Hassock and sleeping support combined, C. C. Taylor 733,768
Heater, H. M. Sturgis 733,437
Heater and steam generator, O. R. Rand, Jr. 733,747
Heating device, W. H. Henderson 733,840
Hoist block for cranes or derricks, C. L. Taylor 733,605
Hoisting apparatus, Dunbrook & Mead 733,469
Hoisting apparatus, G. Blaauw 733,615
Hoisting motor, A. A. Ball, Jr. 733,614
Hollow mill, W. B. Pearson 733,870
Hoof pad, W. J. Kent 733,656
Hop separating machine screen, J. Muller .. 733,732
Hose supporter, lady's and child's, L. A. Yost 733,927
Hot water furnace, W. R. Thomas 733,923
Hub and roll back, C. J. Caley 733,368
Hydrant, C. L. Howes 733,483
Hydrocarbon burner, J. Fitton 733,579
Illuminating device and reflector for showcases, W. A. Merritt 733,670
Implement handle, J. Schwartz 733,919
Incandescent mantle supporting device, Ward & Selden 733,522
Index and indicator for account books, combined, W. C. Hunter 733,844
Index, land, W. A. Ragland 733,677
Inking appliance, J. I. Litchfield 733,491
Insulating mediums, producing, Basenau & Cohen 733,797
Internal combustion engine, V. R. Nicholson 733,417
Jar closure, D. B. Shinnick 733,880
Julep tubes, machine for making, S. K. Green 733,714
Key operated machine casing, D. E. Felt .. 733,379
Kindling block, E. Pollard 733,675
Knitting machine needle bars, machine for making straight, W. D. Richter 733,425
Lacing for shoes, etc., W. F. Hall 733,837
Lamp and battery, combined portable electric, Sutherland & Marcuson 733,766
Lamp attachment, arc, Lawrence & Nichols 733,664
Lamp globe holder, arc, R. H. Read 733,596
Lamps, series resistance for gas or vapor electric, S. E. Flichtner 733,381
Lamps, starting device for gas or vapor electric, S. E. Flichtner 733,380
Lantern, signal, P. Abraham 733,892
Last, shoe, F. Kellner 733,846
Lifting jack, R. B. Murphy 733,414
Limb, artificial, E. H. Erickson 733,472
Line casting machine, W. S. Scudder 733,559
Linotype machine nipple, J. B. Allen 733,571
Liquid fuel burner, J. B. Bladon 733,693
Liquid separator, centrifugal, C. A. & O. W. Hult 733,585
Litharge, making, J. W. Bailey 733,896
Loading device, automatic, T. M. Park 733,418
Lock. See Padlock
Lock shoe, W. L. Denson 733,543
Logging spool, R. Barr 733,795
Loom, N. M. Shinn 733,434
Loom for making laces, A. Ronsdorf 733,426
Loom harness, Knibbs & Sterrett 733,660
Loom, lappet, H. Ledoux 733,490
Loom needle motion, G. F. Hutchins 733,586
Loom picker stick mechanism, W. H. Kelley 733,655
Loom shuttle cop carrier or spindle, M. Goodwin, Jr. 733,386
Loom shuttle, weft detecting, R. Slack 733,601
Loom weft replenishing mechanism, E. A. Thissell 733,884
Lumber seasoning apparatus, B. B. Gray .. 733,835
Mail bag closure, C. A. McKinney 733,914
Mail box, F. F. Hunter 733,651
Mail box, W. G. Dougall 733,704
Mail delivery bag, J. F. Stroh 733,765
Mangle, K. Henrikson 733,645
Manifolding device, H. H. Norrington 733,736
Massaging implement, C. S. Whitney 733,784
Massaging instrument, B. E. Joseph 733,398
Measuring and filling machine, T. Smith .. 733,682
Measuring apparatus, illumination, D. Burnett 733,538
Measuring gage, R. C. Wright 733,690
Mechanical movement, M. Holman 733,482
Medicated plaster, F. J. Nash 733,504
Metal anode, H. E. Starrett 733,602
Metal sheets, machine for piling, Goldsmith & Bennett 733,385
Metal sulfates from mattes, obtaining, O. Meurer 730,590
Metallic post, J. W. Altmyer 733,792
Metallic wheel, J. H. Haskins 733,717
Metallurgical processes, apparatus for use in, J. H. Officer, et al 733,739
Milk pasteurizing apparatus, L. Sturges 733,604
Miner's crate, G. R. MacDonald 733,552
Mining cage safety chair, Hanson & Dwight 733,907
Miter box, R. H. Dorn 733,823
Moistening and sealing apparatus, envelope, W. Henderson, Jr. 733,392
Mop, C. Morgan 733,554
Mop head, H. Bitner 733,537
Mop head, C. Morgan 733,555
Motor controller, alternating current, A. Kimble 733,401
Motor controlling device, alternating current, D. L. Lindquist 733,550
Musical instrument, electrically operated, G. H. Davis 733,702
Musical instrument playing mechanism, F. R. Wyckoff 733,528
Musical instrument, self-playing, W. M. Stine 733,764
Musical instruments, spool for use with automatically playing, A. W. Nunn ... 733,738
Nebulizer, R. L. Benson 733,364
Necktie, O. W. Peterson 733,871
Nipple, safety, F. A. Colwell 733,372
Nozzle and tap, combined, W. J. Dalton .. 733,701
Nut, axle, S. R. Bailey 733,532, 733,533
Nut lock, O. P. Broyles 733,457
Nut lock, P. C. Secor 733,754
Nut lock, J. G. Brandon 733,808
Nut lock, G. B. M. Pike 733,915
Obstetrical forceps, H. E. Koch 733,402
Oiling device, axle, T. S. Philpott 733,420
Ore, etc., apparatus for handling, Hoover & Mason 733,647
Organ and pneumatic-action therefor, self-playing, J. E. Prante 733,917
Oven deflector, M. Flannery 733,474
Ozonizers, arrangement for the support and cooling of statical, M. Otto 733,674
Packing, piston rod and valve stem, J. Janda 733,588
Packing ring, piston, H. Lemp 733,665
Pad. See Hoof pad.
Padlock, permutation, T. A. Dinsmore 733,820
Pail ear, J. Easker 733,470
Paper box end closing machine, C. Redd 733,507
Paper holder, O. Harriman 733,480
Paper making machine, O. M. Farwell 733,709
Pasting up the ends of cartons, etc., machine for, R. F. W. Beardsley 733,453
Pen inking device, draftsman's, H. W. H. Powel 733,594
Pen, self-filling fountain, C. A. Faber 733,827
Phonograph sound records, apparatus for duplicating, C. Walcutt 733,521
Photographic cartridge film, flexible, P. B. Cady 733,539
Piano-action adjustment, H. Mallebre 733,725
Piano music desk, H. Mallebre 733,724
Picture exhibitor, U. L. Berger 733,802
Picture frame adjustable regulator, Brown & Chenery 733,809
Picture frame or easel, G. Mendel 733,860
Pigments, making, W. J. Armbruster 733,612
Piling, sheet, L. P. Friestedt 733,713
Pipe coupling, O. A. Thans 733,685
Pipe molding apparatus, T. D. Young 733,529
Pipe or conduit coupling, W. W. Benson .. 733,535
Pipe or rod coupling device, A. Sundh 733,568
Pipe wrench, N. Boulanger 733,617
Pipe wrench, J. B. Tupper 733,770
Pipes, conduits, etc., coupling for, W. W. Benson 733,534
Plaiting machine, D. L. Chandler 733,694
Planter, seed, W. H. Ledbetter 733,912
Plow, A. G. Steele 733,761
Plowshare holder, O. B. Graves 733,387
Pocket, safety, T. C. Louden 733,666
Polarity indicator, F. P. Cox 733,627
Polish, J. F. Myers 733,591
Poultry trough, B. F. Williams 733,448
Powder, glazing, A. I. Du Pont 733,741
Powder glazing apparatus, A. I. Du Pont .. 733,742
Power transmitting device, J. Schneible 733,600
Precious metals from their ores, extracting, Maxwell & Sawyer 733,859
Pressure regulated switch, A. Sundh 733,561
Pressure roller, F. I. Dana 733,630
Printers' furniture, mold for casting, I. Baas 733,531
Printers' metal furniture, making, I. Baas .. 733,895
Printing frame automatic register, O. H. Eichler 733,706
Printing machine, flat bed oscillating cylinder, T. Cossar 733,461

(Continued on page 74.)



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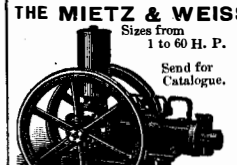

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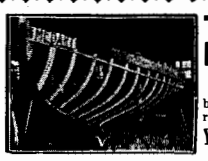

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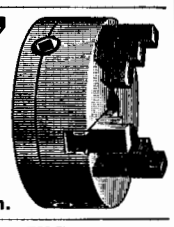

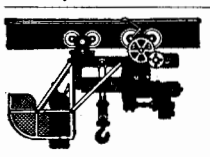

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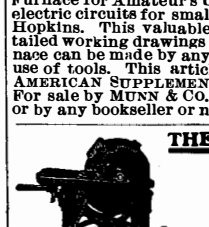

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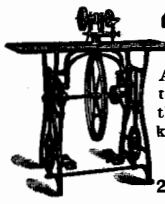

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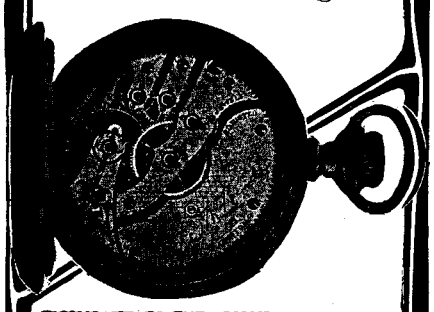

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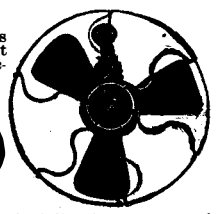

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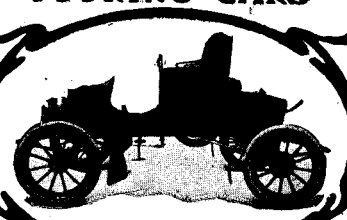

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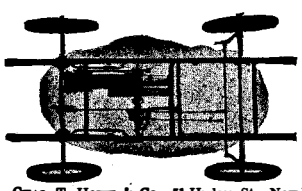

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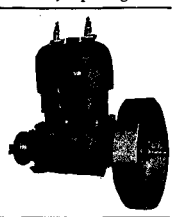

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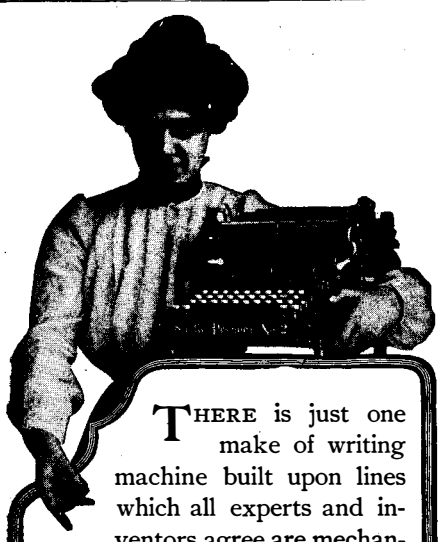

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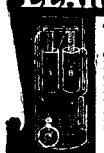

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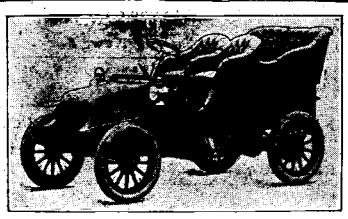

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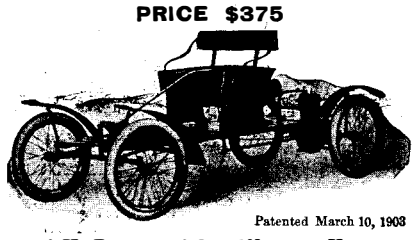

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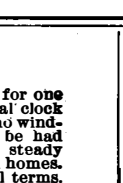

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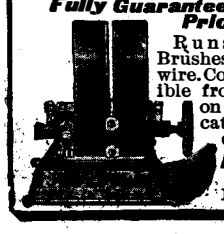

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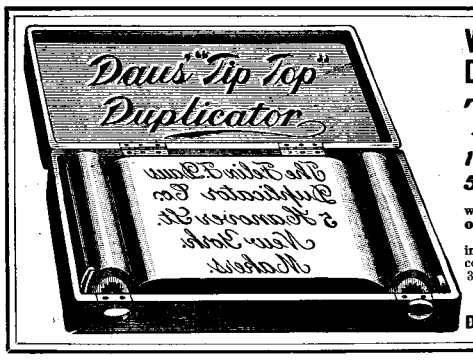

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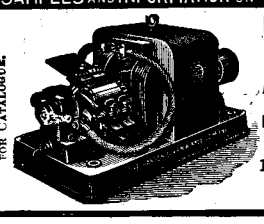

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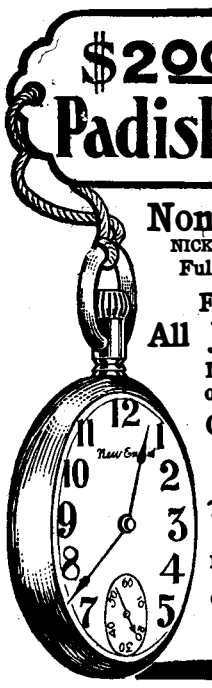

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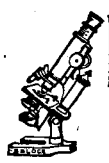

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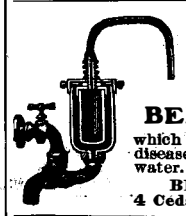

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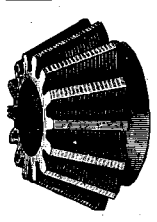

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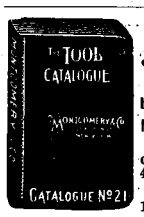

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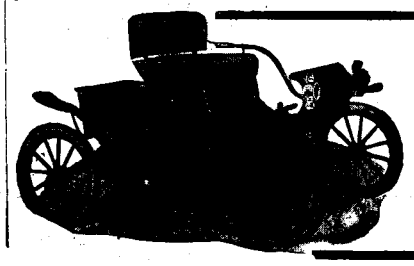

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